National Recovery Plan for the

PIPING PLOVER

(Charadrius melodus)

Recovery of Nationally Endangered Wildlife

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National Recovery Plan for the

PIPING PLOVER

(Charadrius melodus)

prepared by
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Disclaimer

The National Recovery Plan for the Piping Plover (*Charadrius melodus*) has been prepared by members of the Atlantic and Prairie Piping Plover recovery teams, in consultation with others, to define recovery actions that are deemed necessary to protect and recover the species. The plan does not necessarily represent official positions of all jurisdictional agencies and/or views of all the individuals involved in its formation. The goals, objectives, and recovery actions identified in the plan are subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations, as well as to modifications resulting from changed objectives or new findings.

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Definitions of terms and risk categories

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)

SPECIES: any indigenous species, subspecies, variety or geographically defined population of wild fauna and flora.
EXTINCT: a species that no longer exists.
EXTIRPATED: a species no longer existing in the wild in Canada, but occurring elsewhere.
ENDANGERED: a species facing imminent extinction or extirpation.
THREATENED: a species likely to become endangered if limiting factors are not reversed.
SPECIAL CONCERN (formerly "vulnerable"): a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
NOT AT RISK (formerly "not in any category"): a species that has been evaluated and found to be not at risk.
DATA DEFICIENT (formerly "indeterminate"): a species for which there is insufficient scientific information to support a designation.

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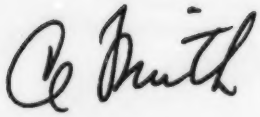
Approved:		Mr. Arthur Smith Director, Fish and Wildlife Division Dept. of Fisheries, Aquaculture & Environment, Government of Prince Edward Island
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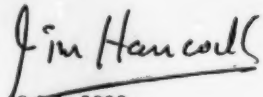
Approved:		Mr. Jim Hancock Director, Inland Fish and Wildlife Dept. of Tourism, Culture and Recreation Government of Newfoundland and Labrador
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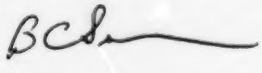
Approved:		Mr. Barry Sabean Director, Wildlife Management Department of Natural Resources Government of Nova Scotia
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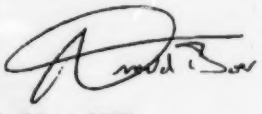
Approved:		Dr. Arnold Boer Director, Fish and Wildlife Branch, Department of Natural Resources and Energy Government of New Brunswick
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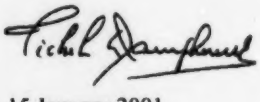
Approved:		M. Michel Damphousse Directeur, Développement de la faune Société de la faune et des parcs du Québec Gouvernement du Québec
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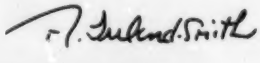
Approved:		Ms. Adair Ireland-Smith Director, Parks Ontario Ministry of Natural Resources Government of Ontario
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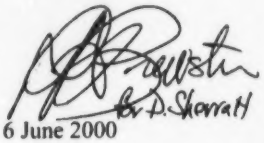
Approved: 
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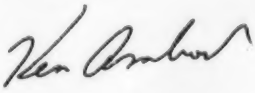
Approved: 
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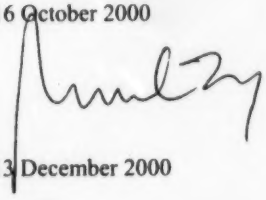
Approved: 
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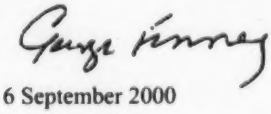
Approved: 
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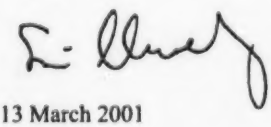
Approved: 
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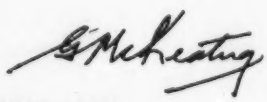
Approved: 
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Recovery plan summary

The Piping Plover (*Charadrius melodus*), a migratory shorebird, breeds in eastern and central Canada and in adjoining regions of the United States. It winters along the Atlantic and Gulf of Mexico coasts of the southern United States, the east coast of northern Mexico and on at least several Caribbean islands. The North American breeding population consists of about 5900 adults of which about 2100 breed in Canada. Approximately 400 adults summer on the Atlantic coast and nearly 1700 on the prairies. As recently as 1977, the Piping Plover bred in the Canadian Great Lakes region, but it is now extirpated as a breeding species from that region.

In 1978, the Piping Plover was listed as Threatened in Canada. In 1985, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) uplisted this species' status to Endangered as a result of continuing population declines. In 2001, COSEWIC further refined the plover's status by listing the two subspecies of the Piping Plover (*circumcinctus* and *melodus*) as Endangered. In the United States, the Piping Plover is designated as "threatened" in the Great Plains and on the Atlantic coast and "endangered" in the Great Lakes region. These designations were made because the species has declined over the past century, especially in the Great Lakes and Atlantic regions, where much of its breeding habitat has been made unsuitable by beach development and other causes.

Two separate regional Canadian recovery teams were created to investigate the plover's ecology and identify its management requirements as both differ in the two parts of its Canadian range. The teams recommend the following national and regional population goals:

National goal: To achieve a self-sustained and well distributed Canadian population of at least 2296 adult Piping Plovers during three consecutive international censuses.

Goal for Prairie population:

- To maintain at least 1626 adults (813 pairs) in the Prairie region with a minimum of 300 adults in Alberta, 1200 in Saskatchewan, 120 in Manitoba and 6 in Ontario (Lake of the Woods) during three international censuses.
- To achieve a median chick fledging rate of greater than 1.25 chicks/pair/year and with no net loss of habitat due to human action.

Goal for Great Lakes area:

- No quantitative goal is specified, because the plover is now extirpated here as a breeding species. Re-establishment does not appear feasible in most areas because of habitat inadequacies and untested reintroduction techniques. Nevertheless, the potential for re-establishment will be evaluated.

Goal for Atlantic population:

- To achieve a population of at least 670 adults (335 pairs) during three consecutive international censuses with no net loss of habitat caused by human actions.
- To achieve a productivity level above 1.5 chicks/pair/year and to achieve habitat protection objectives of a minimum of 65% of nesting plovers in Atlantic Canada protected.
- To evaluate the longer term goal of 800 adults (400 pairs) in relation to habitat availability.

This recovery plan recommends specific research and management activities to be carried out over five years beginning with the 2000 field season. The implementation cost is estimated to be about $4.4 million for activities pertaining to the Prairie Canada populations and $3.8 million for Atlantic activities. The overall national

implementation costs are about $8.2 million. Lower costs, however, will be achieved by linking activities. Priorities have been assigned to tasks, with some differences between Atlantic Canada and Prairie Canada. A general overview of those common priorities is as follows. To prevent continual declines in Piping Plover populations, agencies will give the highest priority to management actions that will protect the species, its key nesting areas and associated habitat. Other primary tasks include identifying threats to Piping Plover habitat and monitoring and evaluating recovery actions to ensure their effectiveness.

Of second priority are research, surveying, management and communication activities required to learn more about the species and its habitats and to obtain better information for management purposes. Public and administrative support also is of secondary priority.

The third priority is actions related to standardizing data, maintaining data files, reintroduction assessments, protocols, techniques and habitat rating.

It is recommended that recovery activities be carried out by federal and provincial wildlife agencies and non-government organizations as per the implementation tasks shown in Section 3 of this plan.

Section 1
Introduction, species' background and status evaluation

1.1 Introduction

The Piping Plover (*Charadrius melodus*) is a small shorebird that is characterized by its unique plumage, moderately high-pitched "pipe" call and its habit of breeding on open sandy and/or gravelly beaches. This migrant breeds only in North America, where its population in 1996 was determined to be about 5900 adults (Plissner and Haig 1997). Shorebird hunting in the past (Tyler 1929), human disturbance, predation during the breeding season and habitat loss/alteration have been suggested as factors contributing to its decreased numbers (United States Fish and Wildlife Service 1994). The species, formerly listed as Threatened (Bell 1978) in Canada, was uplisted in 1985 to Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Haig 1985) and recently, the two subspecies (*circumcinctus* and *melodus*) of this plover were listed separately, as Endangered (Boyne 2001). The Piping Plover is listed as "endangered" in the Great Lakes area of the United States, and "threatened," elsewhere (United States Fish and Wildlife Service 1985).

The Piping Plover breeds in all Canadian provinces except British Columbia, and does not occur in the Yukon, Northwest Territories or Nunavut. In Canada, Piping Plovers arrive on the breeding grounds from mid-April (Cairns 1982) to about mid-May (Haig 1992), and most depart by mid-August (Cairns 1977; Renaud 1979). Pairs form upon arrival on the breeding grounds, where territories are established and defended. Male courtship rituals include exaggerated aerial flights accompanied by calling, nest-scraping and stone tossing. The simple nest consists of a shallow depression, often lined with small pebbles or seashells. Four eggs are normally laid. Incubation is shared by both sexes. Mean incubation period ranges from 26 to 28 days (Haig 1992). If the initial clutch is lost, Piping Plovers may re-nest, usually once or twice, though not necessarily with the same mate (Haig and Oring 1988b). All eggs usually hatch within 4–8 hours (Cairns 1977), but later clutches can take over a day to hatch (Wolcott and Wolcott 1999). One brood is raised per year (Haig and Oring 1988b). Two broods are very rare and have only been seen on the U.S. Atlantic coast (Bottitta et al. 1997).

Most chicks leave the nest the same day they hatch (Cairns 1977). Chicks are frequently brooded by both parents (Haig and Oring 1988b), but there is relatively little brooding after chicks reach three weeks of age (Cairns 1977). Young plovers achieve sustained flight at 21 (Prindiville Gaines and Ryan 1988) to 35 (Wilcox 1959) days of age. Some females abandon their young within 10 days of hatching (Haig and Oring 1988b) leaving the male to finish the brood-rearing process.

Unfortunately, in most years, few chicks survive to fledging. In the Northern Great Plains, on average less than one chick per breeding pair is fledged (Ryan et al. 1993). In Atlantic Canada, about one chick per pair is fledged (Atlantic Canada Piping Plover Recovery Team, unpubl. data).

Juveniles and adults may stage on the breeding grounds (Cairns 1977). After leaving the nesting grounds, plovers migrate to the southern United States, the Caribbean and Mexico (Haig and Oring 1985). Since few Northern Great Plains plovers are sighted during migration, they may fly directly from the breeding grounds to the wintering areas in a single flight. On the Atlantic coast, Piping Plovers move southward in small groups (Haig 1992).

The first migrant Piping Plovers are seen on the Gulf of Mexico coast as early as the second week of July (T. Eubanks, pers. comm. in Haig 1992). On the wintering grounds, Piping Plovers spend most (76%) of their diurnal time foraging. When not foraging, plovers usually rest or preen (Johnson and Baldassarre 1988).

Piping Plovers may benefit from nesting with more aggressive species. Plovers are known to nest near colonies of American Avocets (*Recurvirostra americana*) (Mayer and Ryan 1991), Least Terns (*Sterna antillarum*) (Schwalbach 1988), Common Terns (*Sterna hirundo*) and Arctic Terns (*Sterna paradisaea*) (Cairns 1977). Burger (1987) suggests that Least Tern associations are beneficial to Piping Plovers. This assumption, however, has been questioned for associations with Arctic Terns (Flemming 1987) and American Avocets (Mayer and Ryan 1991).

Little is known about the Piping Plover's diet (Patterson et al. 1990). Because of the precarious status of the species, past studies have been restricted to observations of feeding individuals and/or analysis of faecal samples (Nicholls 1989; Shaffer and Laporte 1994). On the breeding grounds, Piping Plovers are known to feed on a variety of invertebrates, including marine worms, fly larvae, beetles, spiders, grasshoppers, crustaceans and molluscs (Forbush 1925; Tyler 1929; Cairns 1977; Gibbs 1986; Lingle 1988; United States Fish and Wildlife Service 1988b; S. Haig and G. Lingle, unpubl. data; Shaffer and Laporte 1994). Invertebrates are also consumed on the wintering grounds (Howell 1924 in Tyler 1929).

Endangered species often indicate that an ecosystem is in trouble. The Piping Plover is not the only species along the Atlantic coast that has become at risk. The Roseate Tern (*Sterna dougallii*) was listed in 1986 as Threatened and uplisted to Endangered in 1999 (COSEWIC 1999). The Gulf of St. Lawrence aster (*Aster laurentianus*) [now *Symphyotrichum laurentianum*] was listed in 1989 as Vulnerable [now Special Concern] (COSEWIC 1996). The tern was listed for many of the same reasons as the plover (i.e. habitat loss, encroachment and predation by gulls). In the U.S., two other coastal species, the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) and the seabeach amaranth (*Amaranthus pumilus*), along with the loggerhead sea turtle (*Caretta caretta*) are listed as "threatened" (see United States Fish and Wildlife Service 1996).

Re-establishing ecosystem equilibrium is a more profitable solution to damaged ecosystems than species-specific rehabilitation. Development and implementation of beach management strategies that manage human activities and maintain natural coastal processes are required to minimize negative impacts (United States Fish and Wildlife Service 1996).

Coordinated recovery efforts to conserve the Piping Plover began in Canada during the late 1980s (Goossen 1989). Two separate regional Canadian recovery teams (Atlantic and Prairie) were formed, because both the Piping Plover's ecology and management requirements differ between those two regions. An unpublished Canadian Piping Plover Recovery Plan was approved in June 1989 and identified recovery actions for the period 1989 to 1991 (Atlantic and the Prairie Piping Plover Recovery Teams 1989). After 1991, recovery actions increased and continued even in the absence of a formal plan. Guardianship programs were initiated, predator exclosures successfully used in both regions, survey efforts were expanded and included the second international census, fences erected to keep out cattle, artificial islands created, land designations made, public and media awareness heightened and international cooperation increased.

The recovery goal of minimally 2600 individuals (adults) in Canada, as approved in the unpublished 1989 recovery plan, has not been achieved to date. The most recent (1996) estimates of adult populations for Prairie Canada (1687) and Atlantic Canada (422) fall short of the 1989 recovery goals of 2000 and 670 individuals (335 pairs), respectively. The current Prairie population recovery goal (1626) is lower in part, than the 1989 objective, as objectives for the Saskatchewan and Manitoba populations decreased by 50 and 80, respectively. The Atlantic recovery population goal remains the same as in the 1989 plan. The time frame for maintaining recovery population numbers has been increased from five consecutive years to 15 years. The current plan also includes a productivity rate as part of the recovery objectives for each of the two regions, minimum provincial population targets for the Prairie Canada population and a specific habitat protection goal for the Atlantic population. The actions outlined in this plan cover the five-year period from 2000 to 2004 for both regions.

1.2 Evaluation of the Piping Plover's current status

1.2.1 Factors influencing the vulnerability of the Piping Plover and contributing to its endangered status

1.2.1.1 Biological considerations

1.2.1.1.1 Population status and trends

Piping Plover populations have fluctuated over the last century. Early naturalists found the Piping Plover to be "a common summer resident" on the Atlantic coast and "wintering abundantly on the coast of Florida" (Tyler 1929). Around the turn of the last century, Tyler (1929) reports that the Piping Plover approached extinction because of hunting, but he notes that, following passage of the Migratory Bird Treaty Act in 1918, Piping Plover

numbers began recovering. However, recovery was short-lived and declines have been evident since the 1940s (Haig and Oring 1985).

In 1991, an international census of Piping Plovers (Goossen and Haig 1993) provided the first count estimate for the entire North American population: 5488 adults or 2437 pairs (Haig and Plissner 1993; J. Plissner, pers. comm.). This population size was the highest recorded to 1991, but it does not necessarily represent a population increase from earlier estimates (e.g. Haig 1985). Many sites were visited for the first time during the 1991 census, and overall census intensity was unprecedented. In Canada, 1946 adult plovers (823 pairs) were counted (Table 1). The census tallied 1437 adults (589 pairs) in Prairie Canada, and 509 adults (234 pairs) in Atlantic Canada (Haig and Plissner 1993). Four adults (two pairs) were observed on France's islands St. Pierre et Miquelon adjacent to Newfoundland and Labrador (Desbrosse and Etcheberry 1993; Knox et al. 1994). Northern Great Plains sites had higher numbers of Piping Plovers than Atlantic or Great Lakes sites (Haig and Plissner 1993).

Also during the 1991 census, 3451 Piping Plovers were located in the nonbreeding season (63% of the breeding population). As in the breeding census, this survey had the highest estimate of wintering plovers on record. Although census efforts were not equally distributed across the wintering range, about 93% of wintering plovers were located along the United States coast of the Gulf of Mexico and most of these were in Texas (Haig and Plissner 1993).

Results of a mini-census conducted in Atlantic Canada in 1994 indicated an overall decrease from the 1991 population estimates. During the mini-census, 182 pairs and 36 single adults, or a total of 405 adults, were counted (Amirault 1999). Only sites where plovers were observed in 1991 and sites discovered since 1991 were surveyed during the mini-census, and therefore these estimates may be lower if a redistribution of pairs had occurred since the international census.

The second International Piping Plover Census was carried out in 1996. Results from the census suggests that the total North American breeding population count was about 8% greater than the 1991 population count. The 1996 census coverage was greater than that in 1991. Regionally, Atlantic Canada plover numbers were down, but Prairie Canada plovers numbers were up, each by about 17%. The increase in the Prairie Canada population may have been a result of plovers responding to water conditions in the Northern Great Plains. The total Atlantic coast population, however, was greater by about 30%, but in the Northern Great Plains of the United States and Canada, numbers were down by 5% (Plissner and Haig 2000a).

Population trends for the Piping Plover are difficult to determine because of various factors including fluctuations in habitat conditions, the species' mobility, inconsistent census efforts and short-term studies. Population fluctuations are prominent on the Prairies, because precipitation and drought can significantly influence annual habitat availability. Fluctuations also occur within the Atlantic population (Laporte and Shaffer 1994). Storms can modify nesting habitat favourably or unfavourably, thus affecting the number of Piping Plovers on a given beach (Austin-Smith et al. 1994).

1.2.1.1.2 Past and current distribution

Breeding

The breeding range of the Piping Plover can be partitioned into three areas: the Northern Great Plains, the Great Lakes and the Atlantic coast (Fig. 1). The prairie breeding area extends from southeastern Alberta through southern Saskatchewan and Manitoba, to Lake of the Woods (northern Minnesota and northwestern Ontario), and south to northeastern Montana, North Dakota, South Dakota, Nebraska, eastern Colorado and western Iowa (Haig and Plissner 1993). Piping Plovers were first recorded nesting in Kansas in 1996 (J. Plissner, pers. comm.). Oklahoma is the southernmost known Piping Plover breeding location (one record: Boyd 1991) on the Northern Great Plains and Lake Athabasca, in northern Saskatchewan, is at the northernmost limit of the breeding range (Adam 1984). Piping Plovers do not seem to nest at Lake Athabasca regularly (Skeel 1991); however, the lake's significance to Piping Plovers remains unclear, because systematic surveys have not occurred at this location.

Russell (1983) estimated historical Piping Plover numbers along Ontario's Great Lakes at about 150–160 pairs. Confirmed breeding has not occurred along the shores of the Canadian Great Lakes since 1977 (Cadman et al. 1987), although plovers may have bred there as recently as 1988 (Burnett et al. 1989). Once widely distributed in the United States Great Lakes region (Russell 1983), breeding sites are now restricted to beaches along Lake Superior and Lake Michigan (United States Fish and Wildlife Service 1994).

The Atlantic breeding area extends south from Newfoundland and Labrador to St. Pierre et Miquelon (France), Iles-de-la-Madeleine (Québec), Prince Edward Island, New Brunswick, Nova Scotia, Maine,

Table 1
1991 and 1996 North American breeding population counts for the Piping Plover.[1]

	No. of adults		No. of pairs	
Location	1991	1996	1991	1996
Atlantic Coast				
Canada				
New Brunswick	203	146	91	65
Newfoundland and Labrador	7	27	3	11
Nova Scotia	113	79	51	33
Prince Edward Island	110	66	51	29
Québec	76	104	38	51
Total Atlantic Canada	**509**	**422**	**234**	**189**
France				
St. Pierre et Miquelon[2]	4	6	2	3
United States	1466	2153	704	1078
Total Atlantic coast	**1979**	**2581**	**940**	**1270**
Great Lakes				
Canada	0	1	0	0
United States	40	47	17	21
Total Great Lakes	**40**	**48**	**17**	**21**
Northern Great Plains				
Prairie Canada				
Ontario	5	3	2	1
Manitoba	80	60	36	24
Saskatchewan	1172	1348	481	534
Alberta	180	276	70	120
Total Prairie Canada	**1437**	**1687**	**589**	**679**
United States Great Plains	2032	1597	891	698
Total Northern Great Plains	**3469**	**3284**	**1480**	**1377**
Grand totals				
Canada	1946	2110	823	868
France (St Pierre et Miquelon)	4	6	2	3
United States	3538	3797	1612	1797
North American totals	**5488**	**5913**	**2437**	**2668**

[1] Adapted from Plissner and Haig 1997; J. Plissner, pers. comm.; Plissner and Haig 2000a.
[2] Located off the south shore of the island of Newfoundland.

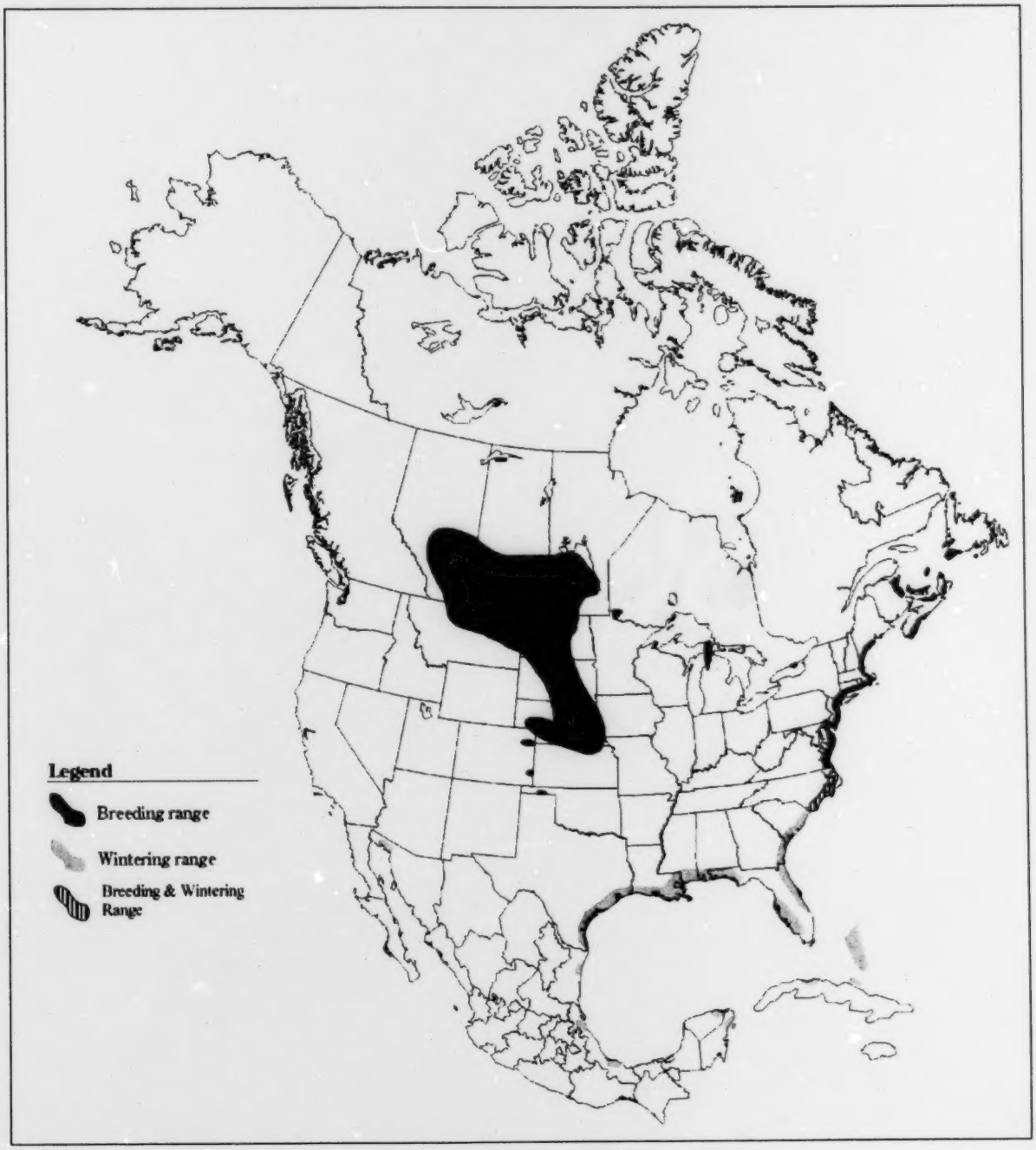
Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina and South Carolina (Haig and Plissner 1993).

Additional breeding sites have been found since the submission of the original status report (Bell 1978) on the Piping Plover to COSEWIC, but the overall distribution in North America has remained relatively constant (Haig and Oring 1985). Some sites no longer support breeding populations including those in Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, New Hampshire, northeastern Newfoundland and Labrador, eastern Québec (mainland) and southern Ontario (see Russell 1983; Haig and Oring 1985; Cadman et al. 1987; Haig 1992; Laporte and Shaffer 1994). Haig and Oring (1985) suggest these gaps may limit movements between regions. At present, however, the two populations are not considered to be genetically distinct (Haig and Oring 1988a).

Wintering

Most Piping Plovers winter along the coastline of the Gulf of Mexico, from Mexico, to Texas, Louisiana, Mississippi, Alabama and Florida. A considerably smaller population winters on the shores of the Atlantic Ocean, from North Carolina to South Carolina, Georgia and Florida (Haig and Plissner 1993). Piping Plovers also occur in small numbers in the Bahamas (Haig and Plissner 1993), and Cuba (Blanco et al. 1993). Based on the sightings of colour-banded plovers, Haig and Plissner (1993) conclude that the vast majority of Piping Plovers wintering along the

Figure 1
Breeding and wintering ranges of the Piping Plover (adapted from Prescott 1997).



Gulf of Mexico breed inland, and those along the southern Atlantic coast breed in coastal areas. The precise wintering location for most Atlantic birds remains unknown. A Piping Plover banded in Atlantic Canada was seen in Florida (Haig and Oring 1988c), and one banded in Cuba was found on the Iles-de-la-Madeleine in 1993, 1994 and from 1996 to 1999, and another one was also observed there in 1996 and 1997 (F. Shaffer and P. Laporte, unpublished data). An adult banded at Marco Island, Florida nested on the Iles-de-la-Madeleine from 1987 to 1990 (Shaffer and Laporte 1992).

1.2.1.1.3 Incidence of disease

There are no data on any occurrence of disease in the Piping Plover (Haig 1992).

1.2.1.1.4 Predation

One of the most important limiting factors in all areas of the Piping Plover's breeding range is predation (see United States Fish and Wildlife Service 1994; Patterson et al. 1991; Haig and Plissner 1994). Known or suspected predators of Piping Plover eggs and/or chicks include coyotes (*Canis latrans*) (Harris 1993), raccoons (*Procyon lotor*), dogs (*Canis familiaris*), skunks (*Mephitis mephitis*), red foxes (*Vulpes vulpes*), mink (*Mustela vison*) (Haig 1992), ground squirrels (*Spermophilus* spp.) (Smith and Heilhecker 1995), Peregrine Falcon (*Falco peregrinus*), Short-eared Owls (*Asio flammeus*) (W. Harris, pers. comm.), Merlins (*Falco columbarius*), American Crows (*Corvus brachyrhynchos*) (Nova Scotia Department of Natural Resources, unpublished data), Black-billed Magpies (*Pica pica*) [now *Pica hudsonia*] (Licht and Johnson 1992), American Kestrels (*Falco sparverius*), Great Horned Owls (*Bubo virginianus*) (Kruse et al. 1993) and gulls (*Larus* spp.) (Whyte 1985; Lambert and Risely 1989). In the United States, there is evidence of ghost crab (*Ocepode quadrata*) and small mammal predation on Piping Plover eggs (Watts and Bradshaw 1995) and on at least one chick (Loegering et al. 1995). However, this type of predation is considered to be rare (Wolcott and Wolcott 1999). Human activities, such as urbanization, have possibly influenced predation (Cairns and McLaren 1980), resulting in the increase of several of the above predators (United States Fish and Wildlife Service 1994). Recreation activities and livestock operations are also probable contributing factors influencing predator species and numbers.

Little is known about adult mortality. Mink (Haig 1992), the red fox (Nova Scotia Department of Natural Resources, unpublished data), the Peregrine Falcon (W. Harris, pers. comm.) and the Merlin (Michaud and Prescott 1999) are known to be responsible for adult predation.

1.2.1.1.5 Competing species

Many instances of competition with humans for beach space have been recorded (Flemming et al. 1988). Natural competition has been less well documented. Because few species nest on beaches or sandbars used by Piping Plovers, competition for habitat is probably minimal. There is one suspected case of an Arctic Tern killing an adult female plover due to competition for habitat (Flemming 1991). Many more species, particularly migrant shorebirds, share Piping Plover feeding sites during spring and summer. Competition may also occur on the wintering grounds as Piping Plovers are found with mixed shorebird flocks (Nicholls and Baldassare 1990b). Studies evaluating potential competition for food at these sites have not been carried out to date.

Only the Snowy Plover (*C. alexandrinus*) fills a similar ecological niche to the Piping Plover, but there are few locations where breeding sympatry of these two species occurs (see Goossen et al. 1994). Interspecific competition is not suspected to be a problem in Canada, but at the fringes of the Piping Plover's range (e.g. Colorado), where more Snowy Plovers than Piping Plovers breed, there may be some competition.

1.2.1.1.6 Food availability

Predation is often cited as the primary factor in chick mortality. However, another hypothesis, that of chick loss through starvation, has rarely been tested. Evidence for this hypothesis has been mixed. At Lake Diefenbaker, Espie (1994) found that potential food was less abundant on nesting beaches compared with beaches where plovers did not nest, and yet a fledging rate of 2.0 chicks/pair was achieved. This implies that food was not a limiting factor in this case (Espie et al. 1992). On the other hand, Loegering and Fraser (1995) found that chicks reared on ocean beaches in Maryland had a lower survival rate than those on interior island and bay beach habitat. They hypothesize that starvation was a factor in survival for ocean beach chicks. In parts of the Great Lakes, food resources appear limited (Nordstrom 1990).

1.2.1.1.7 Natural catastrophes

Storm-induced tidal amplitude on the Atlantic coast can cause nest loss (McAskill et al. 1994) and thereby reduce fledging success (Chiasson et al. 1994). On the Iles-de-la-Madeleine from 1987 to 1992, at least 37% of nests were lost due to flooding as a result of high winds (Shaffer and Laporte 1992). Wind can also cause sand to drift and bury plover nests (D. McAskill, unpubl. data).

Inclement weather, such as extended periods of heavy rain, may result in chick mortality (Flemming et al. 1988; Harris 1993; Murphy et al. 1995). Hail is also suspected of causing chick mortality on the Northern Great Plains (Smith and Heilhecker 1995).

Drought conditions on the Northern Great Plains may result in fewer nests along breeding lakes, although fledging success does not appear to be affected (Weber and Martin 1991). This is not the case at Big Quill Lake in central Saskatchewan (W. Harris, pers. comm.).

1.2.1.1.8 Commercial, consumptive, recreation and scientific use

Piping Plovers are not known to be used for consumptive purposes; however, they do contribute to the ecotourism industry and are of great interest to bird watchers because of their endangered status. The Piping Plover has no known subsistence use or hunting value, but it has been the object of considerable scientific research and volunteer mobilization.

1.2.1.2 Habitat considerations

1.2.1.2.1 Overview of habitat requirements

Along the Atlantic coast, Piping Plovers nest on sandy beaches in areas where vegetation is sparse (Burger 1987; Cairns and McLaren 1980). A recent study in Atlantic Canada found that both sand and sand/cobble substrates were used for nesting (Boyne and Amirault 1999). Gravel, pebbles, rocks, stones, shells, sticks and sometimes beach grass (*Ammophila breviligulata*) appear to influence nest site selection (Flemming et al. 1992a). On the Iles-de-la-Madeleine, Piping Plovers usually nest in unvegetated areas associated with stones and shells (Shaffer and Laporte 1992). Beach areas affected by storm-induced overwashes are favoured (Cairns and McLaren 1980).

In the prairies, nesting most often occurs in sandy, pebbly areas on the shores of shallow alkaline lakes (Whyte 1985; Prindiville Gaines and Ryan 1988; Wershler 1992). Wide beaches are preferred for nesting (Espie 1994; Dundas 1995). Nesting also occurs along the shores of freshwater lakes (Haig 1987; Fey 1993) and riverine sandbars (Purdy and Weichel 1988; Schwalbach 1988; Kirsch 1990).

Piping Plovers have relatively little flexibility when choosing nest sites. A few will use artificial habitats, such as ash ponds (United States Fish and Wildlife Service 1994), an ash lagoon (Switzer 1979), artificial islands (Shaffer and Laporte 1992; Currier and Lingle 1993; Plettner 1993), parking lots (Schwalbach 1988) and sand pits (Sidle and Kirsch 1993).

Feeding habitats in the prairies include seeps (J.P. Goossen, pers. observ.) and lake shores (Whyte 1985). On the Atlantic coast, Piping Plover feeding areas include tidal flats (Cairns 1977), shores of coastal lagoons, ponds and salt marshes as well as wrack lines, washovers, sand flats and mud flats (United States Fish and Wildlife Service 1996). A mosaic of habitat, including large inlets, passes, mud flats, sand flats (Nicholls and Baldassarre 1990b) and algal flats (Haig and Plissner 1993) also appears to be important for wintering plovers.

1.2.1.2.2 Status of breeding habitat

All breeding habitat is important for the Piping Plover's survival. However, most of Canada's Piping Plover nesting habitat lacks beach guardian programs and effective enforcement of legislation prohibiting use of vehicles in nesting areas and is not effectively protected against current or potential human disturbance and development. Protected areas in Canada where plovers nest, include national parks (Corbett 1993), provincial parks (Flemming and Gautreau 1994) and federal national wildlife areas (Chiasson et al. 1994). The Big Barasway Wildlife Reserve in Burgeo, Newfoundland and Labrador, was designated under the provincial Wildlife Act primarily for the protection of Piping Plovers. Newfoundland and Labrador is currently considering further protection to Piping Plover beaches by including them as protected areas under the All Terrain Vehicles (ATVs) regulations. As well, there was a recent closure (summer of 2000) of the beach at J. T. Cheeseman Provincial Park where Piping Plovers nested. In Manitoba, the Clandeboye Bay Special Conservation Area and the Walter Cook Special Conservation Area were established to protect Piping Plover habitat at Lake Manitoba and Lake Winnipeg, respectively. Several Piping Plover nesting areas are recognized as endangered species sites under the Western Hemisphere Shorebird Reserve Network (WHSRN) program (see Appendix 7 in Morrison et al. 1995). Three prairie nesting areas (Beaverhill Lake, Last Mountain Lake and "Quill Lakes") and two Atlantic nesting areas (Tabusintac Lagoon and River Estuary; and Malpeque Bay) are also Wetlands of International Importance or Ramsar sites.

Unfortunately, no legal habitat protection is afforded with a Ramsar or WHSRN designation. Newfoundland Crown Land Reserves offer protection from development pressures. Although no official status is assigned to target beaches in Atlantic Canada, the Piping Plover guardian program there has proven successful in reducing human

disturbance. Several studies have shown increased survival rates where beach guardian efforts have been conducted (LeBreton 1995).

1.2.1.2.3 Existing and future land-use conflicts

A widespread problem in Prairie Canada, is the disruption of beaches by cattle, which use them for loafing, escaping biting insects and for travel lanes between pastures and water sources. One pass by a herd of cattle can disturb Piping Plover nesting habitat by churning up formerly packed gravel surfaces. Disrupting the soil surface also allows for the entry of water and air, thus promoting vegetation growth and thereby reducing the Piping Plover habitat (P. Taylor, pers. comm.).

Grazing after the breeding season may be beneficial in areas with firm substrates, by reducing vegetation growth and improving plover habitat (Smith et al. 1993). The extent and potential long-term effect of cattle trampling on plover habitat has not been well investigated to date.

Oil and gas activities present a relatively minor threat to Piping Plover habitat. In Alberta and Saskatchewan, oil and gas operations near Piping Plover nesting lakes pose potential pollution threats and may have hydrological impacts on nesting basins (Wershler 1992; W. Harris, pers. comm.). Other potential threats include disturbance and habitat loss.

Human recreation pressure presents major threats to plover habitat in Atlantic Canada (This topic is discussed further under Section 1.2.1.2.4.3).

Habitat loss in Atlantic Canada has also been largely a result of construction projects such as summer homes, piers, and roads. These projects often result in additional habitat loss when dune stabilization is required on lands adjacent to construction sites. Dune stabilization reduces plover habitat by hindering natural processes that lead to the formation of pebble nesting areas (Strauss 1990).

In the Iles-de-la-Madeleine and in some parts of New Brunswick, beach cleaning and raking machines remove stones and other biologically significant elements of the beach ecosystem, thereby enhancing the beach area for human use but making it unsuitable for plovers. Damage caused by ATVs on the beaches of the Iles-de-la-Madeleine necessitates dune stabilization.

Wintering habitat is threatened by development, oil spills and dredging activity (Haig and Plissner 1993). Recreational activities may also disrupt Piping Plover foraging (Nicholls and Baldassarre 1990a).

1.2.1.2.4 Effects of human activities

1.2.1.2.4.1 Pollution

In Canada, there is only one known case where Piping Plovers have been directly affected by pollution: the oiling of plovers at Flat Bay, Newfoundland and Labrador. Plovers have been affected by oil spills on the United States Atlantic nesting grounds (United States Fish and Wildlife Service 1996) and on the Gulf of Mexico wintering grounds (T. Amos, pers. comm., in United States Fish and Wildlife Service 1988a). A small sample of eggs from Alberta did not reveal any significant chemical problems (Won 1988; G. Fox, pers. comm.).

Selenium can be problematic for vertebrates at high concentrations but is a necessary trace element (Fannin and Esmoil 1993). Piping Plovers in Nebraska's Platte River valley and South Dakota's Missouri River may be at some risk, as selenium levels are considered high enough in these regions to potentially cause avian embryonic death (see Fannin and Esmoil 1993; Ruelle 1993). Mercury is also a concern in the Platte River valley region (Fannin and Esmoil 1993). In North Dakota, median selenium levels in Piping Plover eggs collected along the Missouri River were lower than concentrations causing malformations and hatching problems (Welsh and Mayer 1993).

Little information is available on the presence of toxins in eggs from Atlantic Canada, but existing data suggest it should not be a major concern at this time. Analyses of addled eggs collected from the Iles-de-la-Madeleine showed low levels of contaminants (P. Laporte, unpublished data). Elsewhere on the Atlantic coast, eggs collected from five sites in New Jersey also showed only trace levels of organochlorides and heavy metals (United States Fish and Wildlife Service 1991).

1.2.1.2.4.2 Research and management activities

The impact of Canadian research and management activities on Piping Plovers has never been fully evaluated.

Predator exclosures, wire cages used to fence in plover nests to protect them from avian and mammalian predators, have been successfully used in various locations (See Section 1.2.3.2.2). Piping Plovers can enter and leave the exclosure, but most predators cannot. Injury or even adult deaths have occurred at predator exclosures used to

protect eggs from predators (e.g. Heckbert and Cantelon 1996; G. Corbett, pers. comm.; J. P. Goossen, unpubl. data; I. Michaud, unpubl. data). Egg losses can occur from exclosed nests (J. P. Goossen, unpubl. data). Along the Atlantic coast, the nest abandonment rate due to use of predator exclosures is 10%. The highest rate of nest abandonment, where exclosures were used, occurred in Atlantic Canada, due perhaps to design and/or weather conditions in that region (Vaske et al. 1994). Benefits of this otherwise generally successful technique may decrease over time as predators learn to associate predator exclosures with potential prey (Austin-Smith et al. 1994).

Leg injuries to banded Piping Plovers (Lingle and Sidle 1993; Lingle et al. 1999) have led to a moratorium of banding activities along the United States' Atlantic coast (Haig and Plissner 1993). In Canada there has been little evidence of banding being detrimental to Piping Plovers.

In Massachusetts, MacIvor et al. (1990) found that research activities on Piping Plovers did not increase nest predation by red foxes. In Atlantic Canada, there are reports of raccoons and crows following a researcher's tracks to Piping Plover nests that were under observation (G. Corbett, pers. comm.).

1.2.1.2.4.3 Human recreational activities

Human disturbance continues to be a major threat to Piping Plovers in Atlantic coastal regions (Haig and Plissner 1994). Increased beach visitation by people, along with their recreational vehicles, poses a considerable threat to critical nesting habitat throughout the region. New recreational developments including personal watercraft, wind surfers and ocean kayaking have the potential to increase conflicts in areas formerly difficult to reach. Piping Plover declines in Newfoundland and Labrador, may be related to increased beach use and ATV activity (Knox et al. 1994). Vehicles on beaches create ruts that make movement from the nest to the wrack line difficult. Both vehicles and pedestrians can crush eggs or chicks inadvertently. Vehicles also degrade habitat by forcing wrack into the sand, making it unavailable for foraging (Goldin 1993).

Cairns (1977) suspected human disturbance accounted for differences in productivity between Cadden Beach and other beaches in Nova Scotia. Later, Flemming et al. (1988) and Strauss (1990) demonstrated that increased human activity on plover nesting beaches results in reduced chick survivorship. Human disturbance may cause plovers to divert energy from chick-rearing, foraging and other essential activities to human avoidance (Flemming et al. 1988; Strauss 1990).

On the prairies, alkali wetlands are rarely used for recreational purposes. However, recreational activities at some prairie freshwater lakes can threaten Piping Plovers. For example, hundreds of thousands of people converge on Lake Winnipeg's beaches each year (Fey 1993), and the use of ATVs is also evident (Koonz 1994).

1.2.1.2.4.4 Water management activities

Manipulation of rivers for hydroelectric power, recreation, irrigation and wildlife poses one of the most serious threats to Piping Plover survival on the Northern Great Plains. Extensive portions of nesting sandbars on the Missouri River have been lost due to channel creation, dams and water removal (Sidle et al. 1991).

Habitat availability is also constrained by vegetation growth on sandbars (Mayer 1993). However, flooding can be beneficial to Piping Plovers by increasing the amount of potential nesting habitat through reducing vegetation on sandbars (Sidle and Carlson 1992). Rising water levels on major rivers, such as the Missouri, also flood out nests (Schwalbach 1988).

In Canada, few Piping Plovers use rivers as breeding habitat. Maximum numbers seen on Prairie Canada rivers are as follows: 46 birds on sandbar habitat of the South Saskatchewan River in 1988 (Purdy and Weichel 1988) and three on the North Saskatchewan River in 1989 (Johnson and Seguin 1989). Little is known about the breeding status and productivity of plovers on these rivers, although nesting has been confirmed on the South Saskatchewan River (Purdy and Weichel 1988). Flooding of sandbar habitat downstream from Lake Diefenbaker is a probable limiting factor for Piping Plovers in some years.

Stabilizing Lake Manitoba has threatened Piping Plover nesting habitat, as it has allowed vegetation to encroach onto beaches (Koonz 1994). At Lake Diefenbaker in Saskatchewan, one of the larger concentrations of Piping Plovers in North America (Skeel 1994) is threatened at times by rising water levels during the breeding season (Espie et al. 1994; Jung et al. 1998). Production, it is believed, can be eliminated on a high water year (Harris and Lamont 1990). Reproductive losses of this magnitude may be substantial to the Prairie Canada population considering the Lake Diefenbaker birds can make up nearly 20% of the prairie population.

1.2.1.2.4.5 Shortage of habitat

Although Piping Plovers have been extirpated from much of their range in the Great Lakes (Russell 1983) there is still some habitat that appears to be suitable (Nordstrom

1990). However, the food supply may be inadequate in some areas to support Piping Plover populations (Nordstrom 1990).

There is other evidence that Piping Plover habitat, thought to be suitable for nesting, is not in short supply. Suitable nesting habitat appears to be available in Oklahoma and Kansas but is only used by a few migrants (Haig and Plissner 1994). Results from the 1991 international breeding census showed that Piping Plovers were found on less than 50% of potential breeding sites (Haig and Plissner 1994). At the Lake of the Woods, not all habitat is being used (Lambert and Risely 1989).

1.2.2 The role of the Piping Plover in the ecosystem and interactions with humans

1.2.2.1 Ecological considerations

1.2.2.1.1 Ecological role

The Piping Plover is a predator which feeds on aquatic and terrestrial invertebrates. Its impact on local invertebrate populations is unknown but is probably minor. Because the plover nests on barren beaches and sandbars and avoids vegetation in its diet, it has no known or probable impact on plant communities. The Piping Plover serves as a prey item for mammals, birds (United States Fish and Wildlife Service 1996) and rarely, for at least one crustacean (Loegering et al. 1995; Watts and Bradshaw 1995; Wolcott and Wolcott 1999). Eggs and chicks are particularly vulnerable to predation. With a continental population of about 5900 broadly scattered adults, the Piping Plover cannot be considered a major dietary staple for any of its predators. Piping Plovers feed in the same habitats as numerous other shorebirds on migration, breeding and wintering grounds. The extent of interspecific competition, if any, for food and space has not been determined. Such competition is probably minimal, particularly on the breeding grounds owing to differences in nesting habitat requirements of resident shorebirds.

1.2.2.1.2 Taxonomic position

The Piping Plover is a member of the Family Charadriidae, in the Order Chardriiformes. It is one of 10 plover species that regularly breed in North America and one of six in North America (American Ornithologists' Union 1983) characterized by at least one breast band. The species has historically been considered to be composed of two subspecies, *C. m. melodus* and *C. m. circumcinctus* (American Ornithologists' Union 1957); however, a recent genetic study combined with other life history, distribution and dispersal information suggests there is no basis for this taxonomic division (Haig and Oring 1988a).

1.2.2.2 Sociopolitical considerations

1.2.2.2.1 Public appeal/existence value

The Piping Plover has several characteristics that give it a special relationship with humans. It is of major interest to naturalists, birdwatchers and the general public, providing the particular thrill associated with observing an endangered species. Its habit of nesting on beaches often brings it in close contact with humans, thus raising its public profile. The Piping Plover is also an excellent rallying symbol which can be used to help protect beaches, dunes, prairie wetlands and other species associated with these habitats.

Once relatively unknown, the Piping Plover has recently enjoyed considerable publicity through the media, magazine articles and educational programs, all due to its endangered status. The plover is a priority species for viewing by birdwatchers and numerous volunteers participate in programs to protect habitat and nests from disturbances.

1.2.2.2.2 Utilitarian value

The Piping Plover was hunted prior to passage of the Migratory Birds Convention Act (1917). Hunting was mostly related to the millinery trade but some egg collection also took place (United States Fish and Wildlife Service 1996). Having little commercial or subsistence value today, outside of ecotourism potential, the Piping Plover's utilitarian value lies mainly in contributing to environmental education, biodiversity strategies and highlighting endangered species concerns. Its presence on public beaches has generated controversy that has promoted considerable debate about human recreational values and priorities in contrast to the protection of beach habitats, associated beach features and endangered species.

1.2.2.2.3 Legal considerations

Canada's Environment Minister has tabled the Species at Risk Act (SARA), and at the time of publication was seeking legislative approval. The main focus of the proposed federal legislation is expected to be the provision of protection for all endangered species on federal lands, as well as enhanced protection for aquatic species and nests of migratory birds elsewhere. Also, the role of COSEWIC will be formalized so that the list of species at risk is established through legislation.

A significant initiative related to the development of the federal legislation is an Accord for the Protection of Species at Risk. Through this accord, a Canadian Endangered Species Conservation Council containing

federal, provincial and territorial ministers has been established. The Council has the legal authority to recognize COSEWIC as the scientific authority for listing species in Canada and complementary provincial legislation will be developed for the effective protection of species at risk throughout the country.

There are five other federal acts with potential application to Piping Plover protection (Foley and Maltby 1995). These acts are as follows: the Canada Wildlife Act, Migratory Birds Convention Act, Canada National Parks Act, Environmental Protection Act and the Environmental Assessment Act.

The Piping Plover is protected as a "migratory game bird" as defined in the Migratory Birds Convention Act. This legislation provides protection against wilful damage to the birds, their nests and eggs. The Canada Wildlife Act states that a site that "supports an appreciable assemblage of rare, vulnerable, threatened or endangered species" can be designated as a national wildlife area (NWA). Land ownership must be federal Crown (Environment Canada) or established via long-term agreement. NWA status provides for strict habitat protection, although activities are regulated entirely through permitting, and there is limited site-specific enforcement. Plovers are also protected within national parks and national park reserves under the Canada National Parks Act (Statutes of Canada 2000, chapter 32). Maximum fines of $150 000 and 6 months imprisonment can be imposed for first offence on summary conviction. The act and related regulation authorize Parks Canada officials to restrict access to specific areas for conservation reasons, including closing access to beaches during the plover's breeding season.

Provincial legislation also affords the Piping Plover some protection. Manitoba, Québec, Ontario and New Brunswick have legislation protecting endangered species (Foley and Maltby 1995) and more recently Nova Scotia, Saskatchewan and Newfoundland and Labrador have also enacted such legislation. Prince Edward Island has enacted the Wildlife Conservation Act, which has provisions for protecting Piping Plovers.

In Atlantic Canada, several laws and regulations are in place which have implications for the protection of Piping Plovers. In the Iles-de-la-Madeleine, municipalities have regulations restricting the use of ATVs on beaches during the summer. Also in Québec, the Act respecting the conservation and development of wildlife has provisions for the protection of endangered species habitat, and indications are that the Piping Plover will soon be listed. This law currently protects intertidal areas used for feeding by Piping Plovers. The Prince Edward Island Environmental Protection Act prohibits vehicle traffic on beaches and dunes. A coastal development policy within the provincial Planning Act promotes the regulation of development projects along coastal areas and ensures that development principles are sustainable. The coastal development policy applies to lands and surface water bodies within 500 m of the mean high water mark. The New Brunswick Trespass Act prohibits the use of any motor vehicle in an "ocean shore area," which includes all land from the low tide line to 300 m above the high tide line. In Newfoundland and Labrador, the ATV use regulations of the Motorized Snow and All Terrain Vehicles Act has some application for Piping Plover habitat protection. Big Barasway Wildlife Reserve was designated primarily for the protection of the Piping Plover under the Newfoundland and Labrador Wildlife Act. There is also the ability to protect beaches under Wilderness and Ecological Reserves legislation and as Crown Land Reserves.

The Nova Scotia Beaches Act prohibits the use of vehicles on designated beaches, the removal or destruction of substrate, vegetation or a watercourse and requires that domestic animals be kept on a leash on beaches that are listed under that legislation. The Nova Scotia Provincial Parks Act has provisions allowing for the establishment of conservation zones within parks and the preparation of management guidelines for the protection of sensitive resources within these zones. It also has general restrictions against the destruction or removal of vegetation or a watercourse, the use of vehicles (except on roadways) and includes requirements for domestic animals to be kept on a leash.

1.2.2.2.4 Proportion of breeding population in Canada

In 1991, the continental breeding population estimate of Piping Plovers was 5488 adults. Thirty-five percent (1946) of these birds occurred in Canada. Of the 3469 adults that bred on the Northern Great Plains, 41% (1437) occurred in Prairie Canada. Along the Atlantic coast, 26% (509) of the 1979 adults counted in 1991 occurred in Atlantic Canada and Québec. Less than 1% (4) of the continental population occurred on France's St. Pierre et Miquelon islands (Haig and Plissner 1993; J. Plissner, pers. comm.).

The 1996 continental breeding population estimate was 5913 adults of which 2110 (36%) were located in Canada. Of the 3284 adults that bred on the Northern Great Plains, 51% (1687) occurred in Prairie Canada. Along the Atlantic coast, 16% (422) of the 2581 adults counted were in Atlantic Canada and Québec. Less than 1% (6) of the continental population were seen on France's St. Pierre et Miquelon islands (Plissner and Haig 2000a).

1.2.3 Recovery potential of the Piping Plover

1.2.3.1 Review of major threats and likelihood of continued threats

The three main threats to the Piping Plover's survival on its breeding grounds are predation, habitat loss or degradation and human disturbance. Habitat loss or degradation is the primary threat on the wintering grounds.

Predation is a serious concern on the breeding grounds where eggs and young chicks are vulnerable to various predators. Agricultural and housing development near breeding beaches can lead to increased predator productivity or survival, thereby increasing populations of predators, such as gulls, raccoons, foxes and skunks. Beach areas having ineffective litter management also tend to maintain unusually high predator populations (e.g. gulls). We anticipate predation to continue to be a serious threat to Piping Plover productivity.

Habitat loss is a problem on both breeding and wintering grounds. It occurs when nesting beaches or basins become unsuitable or unavailable to Piping Plovers through natural causes such as drought, vegetation encroachment, tides and floods, as well as through human activities such as beach visitation, housing developments, cattle ranching and water management. Natural factors will undoubtedly continue to be an unpredictable challenge for Piping Plover recovery in the future, and habitat loss due to human activity will increase with demands for more resources, recreation and living space, as the human population continues to grow.

Direct human disturbance resulting from recreational activities on beaches continues to be a major concern along the Atlantic coast. Although educational and public relation programs help to ameliorate the problem, increasing human use will put further pressure on the beaches used by Piping Plovers. In Prairie Canada, human disturbance through recreational activities is considered to be a minor threat. Conversely, increasing pressure to manage beaches responsibly and reduce vehicle activity have benefited the Piping Plover.

1.2.3.2 Current habitat/recovery protection efforts

1.2.3.2.1 International agreements and arrangements

Four major Piping Plover recovery teams were formed in North America—two in Canada (Prairie team and Atlantic team) and two in the United States (Great Lakes/Northern Great Plains team and an Atlantic team). Although the Great Lakes/Northern Great Plains team was disbanded, two other teams were designated, the Northern Great Plains Piping Plover Recovery Implementation Team (McPhillips 1999) and the Great Lakes Piping Plover Coordination Group. Canada and the United States recognize the importance of international cooperation and therefore are invited to attend each other's recovery team meetings (Goossen 1990a). The recent formation of the International Piping Plover Coordination Group will aid in addressing international Piping Plover issues.

Three Piping Plover recovery plans have been prepared in North America: one unpublished one in Canada (Atlantic and Prairie Piping Plover Recovery Teams 1989) and two in the United States (United States Fish and Wildlife Service 1988a, 1988b). The Canadian plan (this document) and the U.S. Atlantic plan have recently been revised (United States Fish and Wildlife Service 1996), and the Great Lakes/Northern Great Plains (United States Fish and Wildlife Service 1994) is in draft form. Canada and the United States are working together to achieve North American population objectives. Both countries' listing processes would include taking each others goals into consideration if de-listing is warranted (United States Fish and Wildlife Service 1994,1996; this plan).

Regional and national shorebird plans are being prepared in Canada and the United States to provide a more comprehensive approach to shorebird management in North America. Where applicable, the Piping Plover will be included in these plans.

1.2.3.2.2 Conservation activities

Numerous conservation efforts have been undertaken on breeding areas across North America (Goossen 1989,1990b,1991; Flemming and Gautreau 1994; United States Fish and Wildlife Service 1994,1996; Roy and D'Amours 1996; Amirault 1999) particularly to address productivity related problems (Flemming and Gautreau 1994). Public education efforts are widespread (Flemming and Gautreau 1994) and include pamphlets (Anonymous 1993; Goossen 1995), public media (Koonz 1994), magazine articles (Paquin 1988; Sylvester 1991; Goossen and Johnson 1992; Fisher 1995), public speaking engagements (Koonz 1994), education in schools, video productions (D. McAskill, pers. comm.), information panels (Boates et al. 1994) and landowner contacts (MacEachern and Barrett 1988). A draft protocol to assess reproductive success of the Piping Plover will help standardize methodology in the Northern Great Plains (Murphy et al. 1999). Atlas projects documenting Piping Plover site and nesting information will be of value to wildlife managers and environmental assessment reviewers. The New Brunswick, Nova Scotia and Prairie Provinces/Ontario atlases (Amirault et al. 1997; Boates et al. 1994; Goossen et al. 2000) have been completed while

the Newfoundland and Labrador and Prince Edward Island atlases are in preparation. WHSRN endangered species site designations have brought additional recognition to Piping Plover nesting areas in Prairie (Little Fish Lake and Big Quill Lake) and Atlantic Canada (Plover Ground, Kouchibouguac National Park, Prince Edward Island National Park, Kejimkujik [Seaside Adjunct] National Park, Big Barasway Ecological Reserve and Summerville Beach Provincial Park).

Guardian programs on Canada's Atlantic coast (Fisher 1995) and in Manitoba (Fey 1993) have contributed substantially to reducing human disturbance on certain nesting beaches. Collectively, the scores of volunteers participating in these programs provide an invaluable service in educating the public and protecting nesting beaches from human disturbance (Fisher 1995). Stewardship programs, conservation zones and signage are also used to try to decrease human disturbance to Piping Plovers (Flemming and Gautreau 1994).

Predation management is practised on certain nesting beaches in Atlantic Canada through removal or trapping of predators (G. Corbett, pers. comm.). Limited predator control is carried out in the United States Northern Great Plains (Smith and Heilhecker 1995). Predator exclosures have successfully protected eggs to the hatching stages in Atlantic Canada (Corbett 1993), Atlantic United States (Rimmer and Deblinger 1990), Great Lakes (Allen 1989), Prairie Canada (Heckbert and Cantelon 1996; Richardson 1998) and the United States Great Plains (Smith and Heilhecker 1995). Predator exclosures are not always successful, however (see Loegering 1992), and cases of nest abandonment, egg loss and adult mortality occur (Section 1.2.1.2.4.2).

Some efforts have been made to reduce the negative effects cattle have on Piping Plover habitat and their potential threat to eggs and young. Delayed grazing agreements (Anonymous 1995) and fencing initiatives (Alberta Environmental Protection Services, Saskatchewan Wetland Conservation Corporation, former Alberta NAWMP Centre) are two tools that have been used to protect plover habitat in Prairie Canada.

Water management of reservoirs and lakes can enhance nesting and feeding habitats of Piping Plovers but can also hamper their nesting efforts. Alberta's Buffalo Lake Stabilization Project threatens to reduce Piping Plover habitat; however, mitigation efforts are being planned to take advantage of an excellent opportunity to manage nesting shorelines on two basins.

In the United States, the United States Army Corps of Engineers manages Piping Plover habitat along rivers and reservoirs, thereby complying with the Endangered Species Act (Sidle et al. 1991). This work is done in consultation with the Missouri River Natural Resources Committee—Least Tern and Piping Plover Subcommittee. Translocation of nests or eggs (Prellwitz et al. 1995; Jung et al. 1998; Gordon and Kruse 1999) threatened by rising waters has been a relatively successful technique that could be an alternative recovery action, if water management policies remain inflexible or when natural flooding occurs. Steps are being taken in Canada to negotiate a water management solution at Lake Diefenbaker which it is hoped will lead to increased Piping Plover productivity.

1.2.3.3 Degree of habitat management required

Piping Plover habitat is constantly changing in quality and quantity owing to factors such as climate, weather conditions, land use, vegetation encroachment, floods and high tides. Given this constant fluctuation, it is important that all Piping Plover habitat be protected.

Creating or restoring Piping Plover nesting and feeding areas is not considered a high priority recovery action in Canada. Of greater importance is habitat protection directly through legislation and enforcement, as well as indirectly through landowner and public education programs. Protecting all Piping Plover sites is critical (Wershler 1992) because (i) availability and quality of Piping Plover breeding sites are variable (Weber and Martin 1991); (ii) natural catastrophes may cause reproductive losses (Smith and Heilhecker 1995); and (iii) distribution of these birds is variable (Haig and Oring 1988c).

Success in creating or supplementing Piping Plover habitat has been marginal in Prairie Canada and is in the experimental stage in the Atlantic region. Managing vegetation encroachment may be of local concern on government lands and other managed sites, but full-scale habitat management is cost-prohibitive and not considered feasible or desirable at this time.

1.2.3.4 Biological considerations affecting recovery

1.2.3.4.1 Recruitment rate and mortality factors

Piping Plovers breed annually beginning in their first year of life. Although data on lifetime reproductive success are not available (Haig 1992), Piping Plover productivity in the Northern Great Plains is about 0.9 chicks fledged per pair (Ryan et al. 1993).

The Piping Plover can live as long as 14 years (Wilcox 1962), but few individuals survive beyond the age of nine (Wilcox 1959,1962). Within Massachusetts, adult survival is estimated to be 74% and juvenile survival 48% (Melvin and Gibbs 1996). Data on adult survival rate in the Northern Great Plains is limited to data from North Dakota (Ryan et al. 1993) where a mean annual rate of 66% was estimated (Root et al. 1992). Juvenile survival rate in the Northern Great Plains is unknown (Root et al. 1992; Ryan et al. 1993).

Productivity has been estimated at 1.33 fledged chicks/pair/year in the Atlantic United States, 1.39 in Atlantic Canada (United States Fish and Wildlife Service 1996). The Atlantic Canada figure probably overestimates the total Atlantic Canada productivity, as it relates mostly to Piping Plover reproductive success in national parks where the level of protection is high. Melvin and Gibbs (1996) estimate that a minimum productivity rate of 1.25 fledged chicks/pair/year is required to stabilize the Atlantic population.

In the Northern Great Plains (including Prairie Canada), Ryan et al. (1993) estimated productivity to be 0.86. Stabilizing productivity rate was estimated to be 1.13 chicks/pair/year with a rate of population decline of over 7% per year (Ryan et al. 1993). A recent analysis (Plissner and Haig 2000b) agrees with the Atlantic stabilization rate but suggests that for the Great Lakes/Northern Great Plains populations, a rate of over 2.0 chicks/pair/ year is needed. An alternative median rate of 1.25 chicks/pair/year has recently been suggested (M. A. Larson, pers. comm.).

1.2.3.4.2 Minimum viable population

A population viability analysis was conducted on the Atlantic Coast Piping Plover population (Melvin and Gibbs 1996). Results of the population viability analysis indicate that in order to achieve a less than 5% probability of extinction for 100 years, a population of 2000 pairs with a mean annual fecundity of 1.5 chicks fledged per pair must be achieved. Plissner and Haig (2000b) calculated that 1.25 chicks fledged per pair was sufficient for survival for 100 years.

Ryan et al. (1993), using a panmictic model approach, estimated that a fledging rate of 1.13 chicks per pair is required to stabilize the Great Plains/Prairie population and 1.16 chicks fledged per pair to increase the population by 1%. A recent assessment suggests that the stability rate may be a median chick fledging rate of 1.25 chicks/pair/year (M. A. Larson, pers. comm.).

If a metapopulation model approach is taken, analysis of the Great Lakes/Northern Great Plains population suggests a fledging rate of 1.7 chicks per pair is required for a 95% chance of surviving 100 years (Plissner and Haig 2000b). This model suggests stabilization would occur if the rate were increased to over 2.0 chicks/pair.

1.2.3.4.3 Population genetics

Differing opinions have been expressed whether or not to recognize a coastal and an inland subspecies of Piping Plover. Research data does not support this proposal (Haig and Oring 1988a); however, work on this topic is continuing.

1.2.3.4.4 Adaptability

Piping Plovers can adapt to minor changes in their habitat and sometimes nest in artificial habitats (Shaffer and Laporte 1992; Sidle and Kirsch 1993). They may shift from nesting on open beaches to vegetated areas when egg loss increases from bird predation (Flemming et al. 1992a) or in response to coastal storms flooding their nests (S. Flemming, F. Shaffer, and P. Laporte, unpublished data). Burger (1987) suggests that Piping Plovers may have shifted nesting locations in response to increases in red fox predation and human disturbance.

Inclement weather can delay egg-laying and Piping Plovers often re-nest after an unsuccessful nesting attempt (Haig 1992).

1.2.3.4.5 Potential for captive-rearing/egg salvage

Captive-propagation is currently not considered an appropriate recovery strategy due to labour and funding requirements and indications that captive-reared birds are not well adapted to survival in their environment (Atlantic Piping Plover Recovery Team, unpubl. data). However, increased knowledge and refinement of husbandry techniques could be gained if salvage was conducted in situations where nest loss was imminent. Implementing captive-rearing would also provide educational opportunities (e.g. zoos) and increase knowledge of the species' biology, which might eventually be used to enhance recovery efforts in the wild (i.e. life history information, DNA analyses) if populations were to reach critically low levels.

Captive-rearing and release of chicks may be appropriate when many eggs are at risk of being lost to tides, floods or water-level-management activities. Raising Charadriidae in captivity has been demonstrated for several species, including the Killdeer (*C. vociferus*) (Malone and Proctor 1966; Powell and Cuthbert 1993), the Snowy Plover (Page

et al. 1989) and the Piping Plover (Quinn and Walden 1966; N. Wentzell, pers. comm.; Flemming et al. 1992b; Kruse and Pavelka 1999). Captive-reared Snowy Plovers have bred successfully in the wild (Page et al. 1989). Although releases of captive-reared Piping Plovers have occurred, there is little information on their survivorship.

The U.S. Army Corps of Engineers has undertaken the largest known Piping Plover egg-salvage/captive-rearing operation in the Northern Great Plains. The Corps of Engineers' operation was initiated by flood emergencies that occurred on the Missouri River. During 1995–97, 370 Piping Plover eggs were salvaged from Missouri River nests. Although the Corps of Engineers reared most of the salvaged eggs, two zoos were involved with rearing the initial 30 eggs. Of those initial 30 eggs in zoos, 19 birds were successfully raised. The Corps of Engineers released 262 fledged young into the wild during those three years (United States Fish and Wildlife Service and U. S. Army Corps of Engineers, pers. comm.; Kruse and Pavelka 1999).

Captive-rearing and release methods for Piping Plovers could be tested in order to evaluate their practical use in restricted, critical situations. Protocols addressing egg-salvage, captive-rearing and release techniques, and follow-up should then be clearly defined. These protocols should be agreeable among Canadian wildlife management agencies and between Canada and the United States. In addition, research tasks and agency roles need to be identified and coordinated.

Another suggested method to augment Piping Plover productivity is chick-fostering (Flemming 1987). Chick adoption has been successfully demonstrated in several cases (Flemming 1987; Midura et al. 1991; Sylvester 1991). Experimental chick adoption has not been proven effective in all trials (Flemming et al. 1992b). There is debate as to whether the addition of a foreign chick to an existing brood may be detrimental. This must be resolved prior to any implementation of chick-fostering techniques.

A double-clutching experiment has been attempted to determine if this is a viable means of increasing Piping Plover productivity. The technique involves forcing a pair to produce a second clutch and fostering the young to wild pairs with young of their own. Results indicate that this technique should not be implemented at present (Shaffer and Laporte 1992).

Limited Piping Plover funding resources must be allocated toward the more important recovery actions, rather than for captive-rearing and brood manipulation. Protecting plover habitats and the birds themselves should be the top priority.

Section 2
Piping Plover recovery

2.1 Recovery goal

2.1.1 Recovery goal for the Canadian Piping Plover population

To achieve a viable, self-sustained and well-distributed population, within the current (2001) Canadian range. The population size required to achieve this goal is unknown, however, the Canadian recovery goal, based on historical provincial counts and/or estimates, is to achieve at least 2296 adult Piping Plovers (1148 pairs) during three consecutive international censuses (11 years). A viable population has a less than 5% probability of becoming extinct within the next 100 years (United States Fish and Wildlife Service 1996). This should allow for the down-listing by COSEWIC of the Piping Plover to the threatened category. De-listing the Piping Plover would include taking regional Canadian and United States Piping Plover population goals into consideration (see United States Fish and Wildlife Service 1994, 1996). Future population viability analyses may require adjustments to current population goals.

2.2 Recovery objectives

2.2.1 Prairie population objectives

- *Increase Piping Plover populations to at least 1626 adults (813 pairs) and maintain this population average over two additional consecutive international censuses with no net loss of habitat due to human action.*
- *Increase and maintain a median chick fledging rate of greater than 1.25 chicks/pair/year(based on population simulations, M.A. Larson, pers. comm.).*
- *Achieve minimum provincial population targets as follows: Alberta 300; Saskatchewan 1200; Manitoba 120; Ontario (Lake of the Woods) 6.*

2.2.2 Atlantic population objectives

- *Prevent the further decline of the Atlantic Piping Plover population.* This may be achieved by increasing the average fledging rate above 1.5 chicks/pair/year (Melvin and Gibbs 1996) and maintaining it at this level or higher if future evaluations indicate that greater fledging rates are required.
- *Once numbers stabilize, increase Piping Plover population to 670 adults (335 pairs), which is approximately the estimated historical abundance (Cairns and McLaren 1980).* Sustain this average population level during three consecutive international surveys with no net loss of habitat due to human actions. Population goals will be further refined when carrying capacity and population viability is better understood.
- *Evaluate the longer term goal of 800 adults (400 pairs), in conjunction with an assessment of habitat availability.* The 400 pairs target for Atlantic Canada has been estimated as the requirements for establishing a well distributed population along the Atlantic Coast based on population viability analysis (United States Fish and Wildlife Service 1996)
- *Adopt and work towards implementing the goal of protecting a minimum of 65% of the habitat of nesting plovers in Atlantic Canada with emphasis on protection of critical nesting beaches.* Effective protection for critical habitat consists of securing areas with limited coastline development or stabilization, minimal disturbance from humans or domestic animals, restricted use of ATVs and with minimal depredation. Legal protective designation, enhanced law enforcement and guardian programs are needed to achieve the intensive protection required for species survival.

2.2.3 Great Lakes objective

- *Prevent disturbance of the known breeding efforts of Piping Plovers recolonizing the shorelines of the Canadian Great Lakes and protect occupied sites. Encourage protection of other apparently suitable breeding habitats where feasible, including high quality historic sites, using a variety of mechanisms (e.g. voluntary stewardship).*

2.3 Evaluation of recovery efforts

2.3.1 Prairie population recovery effort summary and evaluation

Ontario has been actively involved in recovery efforts of the Piping Plover at Lake of the Woods since 1986. Annual censuses are carried out to document the breeding status of the plover at Windy Point and Sable Islands, Lake of the Woods. Predator exclosures are used to protect eggs from predators and are monitored to determine whether hatching/fledging occurs. Other recovery efforts include private landowner contact on Windy Point, posting of nesting areas to prohibit unauthorized entry during the nesting period, and ongoing liaison with the Lake of the Woods Control Board regarding water-level management on the lake.

In Manitoba, habitat protection, monitoring and communications have been the key activities used to protect the plover since the mid 1980s. Habitat protection through site designations (Clandeyboye Special Conservation Area at the southeast corner of Lake Manitoba, Walter Cook Special Conservation Area along the south base of Long Point in Lake Winnipeg) have been one mechanism to bring public awareness as well as habitat protection to the plover. Surveys at Manitoba's sites including those during the international censuses has unfortunately demonstrated that the plover has seriously declined in this province owing largely to inclement weather conditions and high water having a negative impact on reproductive success. Holding water levels artificially high and stable over time at Lake Manitoba and Lake Winnipeg plays a role in affecting plover habitat availability in Manitoba.

Manitoba has been successful in communicating the plight of the plover to the public through various media outlets and has established a guardian program at Grand Beach, Lake Winnipeg. Habitat island creation at West Shoal Lake has met with some success (nine nests found).

In Saskatchewan, monitoring, research and habitat protection have been the primary efforts undertaken in this province. Numerous surveys not only provide trend data but also provide a reasonable estimate of plover numbers at various Saskatchewan lakes. Various studies have provided insight into plover requirements (Espie 1994; Dundas 1995) and biology (Whyte 1985; Espie et al. 1992). Concerns about water management and Piping Plover productivity at Lake Diefenbaker (Espie et al. 1998) continue to be a focus of research (Jung et al. 1998). Drafting of a conservation plan to mitigate for reproductive losses at Lake Diefenbaker will be initiated in 2000 through the efforts of provincial agencies and Environment Canada.

Major activities related to Piping Plovers in Alberta have included research, habitat management, planning, inventory and communications. Research has focused on breeding biology at key lakes (J.P. Goossen, unpubl. data), with more intensive studies emphasizing factors that affect breeding success (Heckbert 1994; Heckbert and Cantelon 1996). Richardson's (1998) investigation into the use of predator exclosures demonstrated that this technique significantly increased nesting success. Guidelines for using this technique were developed (Richardson 1997). Recently, adult predation associated with predator exclosures (Michaud and Prescott 1999) has prompted researchers to reconsider exclosure design. In spring 2000, researchers tested a different style of exclosure in an effort to reduce or eliminate adult predation.

Habitat substrate mapping around key Piping Plover lakes (Wells and Cornish 1999a,b) and hydrology modelling have also been undertaken. Habitat protection is an ongoing activity with Alberta Environmental Protection responding through a variety of referral systems designed to mitigate the impact of industrial activity on crown land, including Piping Plover lakes.

Also in Alberta, specific management designed to minimize the negative influences of cattle has occurred at Little Fish Lake, Handhills Lake, Killarney Lake, the western most of the Reflex Lakes, Rockeling Bay and "Rider Lake" Burning and snow compaction at Rockeling Bay proved unsuccessful in countering vegetation encroachment.

To facilitate recovery plan efforts, a draft management plan for Piping Plovers was prepared for the province of Alberta in 1991. In 1992, the Alberta ad hoc Piping Plover group was formed with membership from the Alberta North American Waterfowl Management Plan office, Canadian Wildlife Service, Alberta Environmental Protection, Ducks Unlimited, and others interested in

plovers. This group provides the forum for planning Piping Plover work in Alberta and seeks funds to carry out priority work. Several population and habitat inventories have been conducted, including participation in the 1991 and 1996 international Piping Plover censuses. Alberta has produced and distributed a publication, "Alberta's Threatened Wildlife—Piping Plover." More detailed information has been summarized in the document "Status of the Piping Plover in Alberta" (Prescott 1997), published as part of the Alberta Wildlife Status Report Series.

Various approaches to recovery efforts have been taken to conserve the Prairie population. Securement of breeding habitat has been ongoing and ranks as the key component to Piping Plover recovery. Applied techniques such as predator exclosures have been employed and are important to counter the impacts that predators have on plover productivity. Problems with techniques (e.g. adult predation at predator exclosures) must be addressed promptly to minimize losses. Predator control is currently not employed in the prairies; other means such as habitat management and predator exclosures are used to indirectly protect plovers from predators.

Monitoring populations including international censuses has been critical to assessing the trends and status of the species. Communication, an important factor which provides public awareness for this species, needs to be expanded. Research on the prairie population has been somewhat limited and needs to be supported. Population dynamics, reproductive success, adult and juvenile survival are all areas which need to be studied, to benefit provincial, national and international conservation efforts.

2.3.2 Atlantic population recovery effort summary and evaluation

Perhaps the first significant effort to increase the profile of the Piping Plover in Atlantic Canada stems from Winnifred Wake's (nee Cairns) work in the mid-70s. In her M.Sc. thesis, Wake not only described aspects of the biology and behaviour of the species, she also highlighted an apparent relationship between low productivity and high human disturbance throughout much of Nova Scotia. This relationship was later confirmed (Flemming 1984; Flemming et al. 1988), and a specific link was established between human disturbance and poor fledging success. With these studies began the first important efforts at recovery in Atlantic Canada.

Efforts have been made by federal, provincial and nongovernment agencies, with the involvement of many volunteers. This section will give an overview of the recovery efforts undertaken in eastern Canada and will provide the background necessary to understand how priorities were set in the stepdown outline for recovery of the Atlantic Canada Piping Plover population.

The establishment of the international Piping Plover census permitted the first estimates of population size and trends. The first census, conducted in 1991, provided the most complete census of Piping Plovers on their wintering and breeding grounds up to that point. The follow-up census, conducted in 1996, provided the first opportunity to look at range-wide trends in the Piping Plover population. This census will be repeated every five years, with less intense surveys in intervening years, to provide long-term information on the status of Piping Plovers throughout their range.

The goal of most recovery efforts to date has been to reduce human disturbance at nesting beaches. This has been achieved through active site management, beach closures, symbolic fencing, signage, enforcement and education. By the time the species was declared endangered in 1985 (Haig 1985), Prince Edward Island National Park had closed nesting areas to the public during the breeding season. Today, protective measures such as public education programs and beach closures are ongoing in Kouchibouguac, Prince Edward Island and Kejimkujik (Seaside Adjunct) National Parks. At these sites, plovers have the highest degree of protection from human disturbance, and as a result pairs nesting in national parks consistently experience the highest levels of reproductive success in eastern Canada. Some national parks have also used predator management as a method of increasing productivity. The use of predator exclosures has been shown to substantially increase hatching success and overall productivity within national parks. Habitat research is being proposed at the Kejimkujik National Park Seaside Adjunct where controlled vegetation manipulation would be attempted in order to enhance nesting habitat. A decision has not yet been made on whether to proceed with this research. Some provincial parks such as Cheeseman Provincial Park, Newfoundland and Labrador, and Summerville Beach Provincial Park, Nova Scotia, also use symbolic fencing, signs and public education to protect plover habitat.

Outside of national parks, on-the-beach conservation activities are usually performed by Piping Plover guardians. Piping Plover guardian programs have been established in all five eastern Canadian provinces that support breeding Piping Plovers: New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and Quebec (Magdalen Islands/ Îles-de-la-Madeleine). The organization and the approach taken by these programs varies between provinces but they

all work on the principle of local stewardship. Some programs, such as the Nova Scotia Piping Plover Guardians, rely solely on volunteers, while others are able to support guardians through employment programs and external grants. Working in conjunction with provincial wildlife agencies and the Canadian Wildlife Service, these organizations are active in posting breeding areas and speaking with the beach-going public about the plight of this species. Breeding areas are marked off using guardian or Canadian Wildlife Service signs, which request that people respect posted zones. In some cases symbolic fencing is used. When contacting the public on the beach, not only do guardians further emphasize the request to stay out of the posted zone, they provide pertinent information to interested people. This pro-active and positive attitude program has been a great public success. In past years, protected beaches on the Acadian Peninsula, those that either had full-time guardians or were naturally inaccessible to humans, had higher fledging success than unprotected beaches. Similar results have been reported in other guardian program efforts. Today, there are over 100 volunteers working in Atlantic Canada in an effort to stabilize Piping Plover numbers. Guardian programs have become an integral part of the recovery process, as financial and staff restrictions prevent government agencies from being able to initiate the on-the-beach conservation efforts required to reduce the impact of human disturbance.

Some Piping Plover guardian programs such as those run by the Island Nature Trust in Prince Edward Island, the Piper Project/Projet Siffleur on the Acadian Peninsula, New Brunswick, and Attention Fragîles on the Magdalen Islands have combined protective efforts at the breeding areas with a strong educational element in the local communities. Piper Project has made presentations in schools and set up educational displays in malls and in many other public places throughout the Acadian Peninsula. These organizations have contacted enough people on the Acadian Peninsula and on the Magdalen Islands, that it would be hard to imagine a household in either region that does not have at least one member who is aware of the plight of this species. Recent attempts have been made to address educational needs through a poster contest in southwestern Nova Scotia where the biggest threat to plovers continues to be human disturbance.

Provincial agencies have been involved in protecting nesting habitat through the establishment of protected areas, developing regulations restricting the use of ATVs and through the establishment of no-entry buffer zones around nests. New Brunswick has also drafted a Coastal Zone Policy, which when finalized would restrict development and use of coastal lands and provide buffers around coastal areas from development.

Recently, seasonal enforcement officers have been used to enforce laws prohibiting vehicles from driving on beaches in New Brunswick and Prince Edward Island and to inform people of the harm that can be done by this activity. This initiative has successfully reduced the number of vehicles on New Brunswick beaches and with more effort, similar success is expected in Prince Edward Island. Enhanced enforcement and on-site education have also resulted in a marked decrease in the number of vehicles on beaches in the Magdalen Islands and in the Acadian Peninsula of New Brunswick. These activities should be continued and possibly expanded into new areas where vehicle violations are a major threat to nesting plovers.

The acquisition and protection of significant Piping Plover nesting areas is also important as coastal development is currently placing pressure on important Piping Plover habitats. Organizations such as The Nature Conservancy of Canada have purchased land important to nesting plovers such as Cedar Road (Tabusintac Sandspit) and Round Bay, Nova Scotia. J. D. Irving Limited has established the Irving Eco-Centre: La Dune de Bouctouche which protects a 14-km sand spit in New Brunswick which once may have had a nesting population of 30 Piping Plovers. Vehicles are now prohibited from driving on the spit, and nests are posted and protected by guardians. Protected areas provide varying degrees of protection to nesting birds. Landowner stewardship needs to be explored because much of the Piping Plover habitat in eastern Canada is privately owned. Conservation easements could be an effective tool to protect coastal habitat. In 1999, an effort to investigate landowner interest in stewardship was undertaken by the Nova Scotia Nature Trust with the support of the Canadian Wildlife Service.

Despite these recovery initiatives and local increases in the number and fledging success of plovers, the overall population of Piping Plovers in eastern Canada has continued to decline. Research has shown the detrimental effects of human disturbance on Piping Plover reproductive success and has provided insight into their habitat use, time and energy budgets, and the species' response to environmental conditions such as rain and wind; however, there is much that we do not understand. Research is still required to determine juvenile and adult survival and dispersal, and to determine where plovers from this region winter. Until we address these issues, we cannot rule out the possibility that threats on the wintering grounds causing low survival rates may be contributing to the decreases observed in the regional breeding population. A Piping Plover banding project, initiated by the Canadian Wildlife Service in 1998 in cooperation with provincial and other agencies, should provide more insight into these research topics.

Virtually all recovery efforts in eastern Canada that have been initiated to date have been a result of partnerships and agreements between the federal, provincial and nongovernment agencies involved in Piping Plover conservation efforts. The Atlantic Canada Piping Plover Working Group facilitates the recovery of the species by bringing these stakeholders together annually to discuss projects and forge partnerships. This group works closely with the Atlantic Canada Piping Plover Recovery Team. Recovery efforts have already resulted in increases in public awareness, habitat protection and enforcement, resulting in local increases in numbers and fledging success. As these efforts are ongoing, future successes are inevitable.

2.4 Strategies for achievement of recovery goal and objectives

2.4.1 Prairie strategies

2.4.1.1 Monitor Piping Plover populations and habitats to determine population size and trend, productivity and distribution and to evaluate the effectiveness of recovery programs.

2.4.1.2 If potential new breeding sites are identified, census Piping Plovers.

2.4.1.3 Encourage and/or assist U.S., Cuban, Mexican and Caribbean officials to identify and census winter Piping Plover habitat.

2.4.1.4 Determine productivity of Piping Plovers at specific sites.

2.4.1.5 Evaluate effectiveness of management actions.

2.4.1.6 Monitor breeding and staging habitat to evaluate habitat quality and availability.

2.4.1.7 Provide managers with current population, productivity and habitat data.

2.4.1.8 Collect unhatched eggs and test for chemical contamination.

2.4.1.9 Protect and manage breeding habitat.

2.4.1.10 Protect the Piping Plover under legal and other protocols.

2.4.1.11 Maintain public and administrative support.

2.4.1.12 Monitor and evaluate effectiveness of recovery actions.

2.4.1.13 Manage and enhance populations.

2.4.1.14 Communications.

2.4.2 Atlantic strategies

2.4.2.1 Monitor population status and distribution.

2.4.2.2 Define habitat requirements.

2.4.2.3 Determine population size and productivity needed to attain population goals.

2.4.2.4 Protect and enhance habitat.

2.4.2.5 Initiate and support Piping Plover research to aid in recovery efforts.

2.4.2.6 Develop and implement public information and education programs.

2.4.2.7 Implement actions required to protect and manage breeding habitat. [This is missing from stepdown outline]

2.4.2.8 Evaluate recovery actions annually.

2.5 Stepdown outline for recovery of the Prairie Canada Piping Plover population

2.5.1 Monitor Piping Plover populations and habitats to determine population size and trend, productivity and distribution and to evaluate effectiveness of recovery programs.

2.5.1.1 Carry out population surveys to determine size of local, regional, national and international populations. (2)

2.5.1.1.1 Continue to participate in the international survey every five years by censusing all known and potential Piping Plover breeding sites in Canada. (2)

2.5.1.1.1.1 Publish provincial and national survey results. (2)

2.5.1.1.2 Assist with the international survey every five years on wintering habitats. (2)

2.5.1.1.3 Census key Piping Plover sites annually to determine population trends at regional sites. (2)

2.5.1.1.4 Evaluate accuracy of single visit censuses by comparing results with known populations. (2)

2.5.2 If potential new breeding sites are identified, census for Piping Plovers. (2)

2.5.3 Encourage and/or assist U.S., Cuban, Mexican and Caribbean officials to identify and census winter Piping Plover habitat.

2.5.3.1 Assist in the identification of, and support protection initiatives for, Piping Plover winter habitat. (2)

2.5.3.2 Liaise with United States wildlife agencies to ensure winter habitats are protected. (2)

2.5.3.3 Encourage and/or assist Mexican and Cuban wildlife officials to identify and protect winter habitat. (2)

2.5.4 Determine productivity of Piping Plovers at specific sites.

2.5.4.1 Annually monitor key sites to determine productivity trend. (2)

2.5.4.1.1 Carry out intensive productivity studies at specific sites to accurately determine productivity. (2)

2.5.4.1.2 Carry out two censuses at selected sites to determine number of breeding adults in late May/early June and number of adults and chicks in early July. (2)

2.5.4.2 Determine if and how productivity varies in different habitat types. (2)

2.5.4.2.1 Compare productivity of parkland breeding sites with prairie sites, including habitat correlates. (2)

2.5.4.2.2 Determine productivity at wetlands and reservoirs managed for other purposes. (2)

2.5.5 Evaluate effectiveness of management actions.

2.5.5.1 Determine population size and productivity at sites managed for Piping Plovers. (2)

2.5.5.1.1 Assess and describe habitat response to management action. (2)

2.5.5.1.2 Assess compliance with habitat protection measures. (2)

2.5.6 Monitor breeding and staging habitat to evaluate habitat quality and availability.

2.5.6.1 Develop standard methodology to assess habitat quality and availability in consultation with United States recovery teams. (3)

2.5.6.2 Rate habitat quality and habitat availability at all sites censused during the 2001 international census. (3)

2.5.6.3 Determine diet of Piping Plovers. (2)

2.5.6.3.1 Document potential prey in breeding and feeding sites. (2)

2.5.6.3.2 Determine prey items through faecal and isotope analyses. (2)

2.5.6.4 Identify threats to habitat quality and availability. (1)

2.5.6.5 Document all threats during any census or study undertaken. (2)

2.5.6.6 Document threats at all sites during the international census. (2)

2.5.7 Provide managers with current population, productivity and habitat data.

2.5.7.1 Identify standard data to be collected during any census. (3)

2.5.7.2 Conservation Data Centres in Ontario, Manitoba, Saskatchewan, Alberta and CWS in Alberta will act as the principle data storage and retrieval centres. (3)

2.5.7.2.1 Field biologists will forward all survey data to the provincial coordinator, who will forward data to the provincial/CWS repository. (3)

2.5.7.2.2 The data centres will provide data at request to government and industry, after clearance by the provincial/CWS Piping Plover coordinator. (3)

2.5.8 Collect unhatched eggs and test for chemical contamination. (2)

2.5.9 Protect and manage breeding habitat.

2.5.9.1 Identify all breeding habitat. (2)

2.5.9.1.1 Identify breeding areas. (2)

2.5.9.1.2 Maintain records of all sites used by breeding Piping Plover. (2)

2.5.9.1.3 Identify features of good Piping Plover breeding habitat. (2)

2.5.9.2 Protect Piping Plover breeding habitat. (1)

2.5.9.2.1 Through the environmental assessment process identify the potential impacts on Piping Plover of all project proposals which may affect Piping Plover breeding habitat and ensure developments do not negatively impact the Piping Plover. (1)

2.5.9.2.2 Place a protective status on all Piping Plover habitats on crown lands (including lake beds) to ensure land is not developed for incompatible uses or privatized. (1)

2.5.9.2.3 Purchase or protect through easements privately held parcels of Piping Plover habitat. (1)

2.5.9.2.4 Recognize and acknowledge role of owners and lessees of Piping Plover habitat. (1)

2.5.9.3 Protect and manage the watersheds on which breeding Piping Plover depend. (1)

2.5.9.3.1 Maintain or restore favourable water regimes at Piping Plover breeding sites. (1)

2.5.9.3.1.1 Determine the cause of fluctuations in water levels observed at many prairie saline lakes. (1)

2.5.9.3.1.2 If significant long-term changes to water regimes of saline lakes are identified determine appropriate responses to maintain Piping Plover. (1)

2.5.9.3.1.2.1 Identify impacts on Piping Plover habitat at each basin. (1)

2.5.9.3.1.2.2 Identify options to restore the natural water regime at each basin. (1)

2.5.9.3.1.2.3 If the natural water regime cannot be restored at a basin identify other management options. (1)

2.5.9.3.1.2.4 Implement the management options which is best for Piping Plover and the natural ecosystem. (1)

2.5.9.3.1.3 Negotiate changes to water regimes of managed lakes and rivers which are more favourable to Piping Plover,where alterations have created habitats of low productivity. (1)

2.5.9.3.1.3.1 Negotiate and implement favourable changes to water regime at Lake Diefenbaker. (1)

2.5.9.3.1.3.2 Negotiate changes to water regime at Lake of the Woods. (1)

2.5.9.3.2 Monitor and maintain water quality at Piping Plover sites. (1)

2.5.9.3.2.1 Use regulations to prevent pollution of the watershed by toxic chemicals, sewage or other harmful factors. (1)

2.5.9.3.2.2 Use the environmental assessment process to identify and prevent potential new negative impacts on water quality. (1)

2.5.9.4 Manage Piping Plover breeding sites to reduce mortality and increase productivity. (2)

2.5.9.4.1 Manage breeding areas to reduce attractiveness to predators. (2)

2.5.9.4.1.1 Maintain wide open beaches which are unattractive to predators. (2)

2.5.9.4.1.1.1 Allowing natural water cycles to occur. (2)

2.5.9.4.1.1.2 Control beach vegetation by using water control, fire, and other environmentally safe methods. (2)

2.5.9.4.1.1.3 Reducing risk from avian predators by removing trees growing on former lake bottoms near Piping Plover beaches taking impacts on other species into consideration. (2)

2.5.9.4.2 Enhance productivity of breeding areas by creating artificial seeps and ponds where drought or low water leaves nesting habitat far from good feeding areas. (2)

2.5.9.4.3 Enhance nesting habitat by providing suitable substrate such as gravel or ridges above flooding threats. (2)

2.5.9.4.4 Prevent damage by livestock to Piping Plover breeding areas. (2)

2.5.9.4.5 Prevent damage by recreational use of ATVs on Piping Plover breeding areas. (2)

2.5.9.4.6 Prevent other human disturbances which may be detrimental to Piping Plover. (2)

2.5.9.4.7 Remove attractions to predators in Piping Plover areas. (2)

2.5.9.4.7.1 Close or clean up garbage dumps or other food sources near Piping Plover sites. (2)

2.5.9.4.7.2 Identify and remove or modify old buildings and other structures so they no longer provide hibernation sites for raccoons and other predators. (2)

2.5.10 Protect the Piping Plover under legal and other protocols. (1)

2.5.11 Maintain public and administrative support. (2)

2.5.12 Monitor and evaluate effectiveness of recovery actions. (1)

2.5.13 Manage and enhance populations.

2.5.13.1 Increase productivity (where other treatments fail) through predator exclosures, predator fences and predator management. (2)

2.5.13.2 Prevent human disturbance to reduce Piping Plover mortality. (2)

2.5.13.3 Model population to understand trends. (2)

2.5.13.4 Improve our understanding of Piping Plover biology at different ecological systems and sites. (2)

2.5.13.5 Assess potential for recolonization in the Canadian Great Lakes. Evaluate historical and other potential breeding habitats and identify high priority areas for habitat protection, using a variety of mechanisms. Collaborate with the U.S. to prepare conservation management strategies in the event Piping Plover recolonization occurs in the Great Lakes. (2)

2.5.14 Communications.

2.5.14.1 Coordinate recovery actions across the species' range. (2)

2.5.14.1.1 Coordination of recovery teams. (2)

2.5.14.1.1.1 International coordination. (2)

2.5.14.1.1.1.1 Cross membership and information/data exchange. (2)

2.5.14.1.1.1.2 Formal sharing of goals and strategies through a Memorandum of Understanding. (2)

2.5.14.1.1.1.3 Support appropriate conservation action in other jurisdictions by team or appropriate bodies. (2)

2.5.14.1.1.2 National coordination. (2)

2.5.14.1.1.2.1 Share goals and strategies formally with pursuit of regionally appropriate recovery actions. (2)

2.5.14.1.1.2.2 Initiate cross membership of Atlantic and Prairie team chairs. (2)

2.5.14.1.1.2.3 Coordinate Piping Plover recovery actions with other species and ecosystem management programs. (2)

2.5.14.1.1.2.3.1 Communicate and exchange information with other recovery/wildlife management teams or programs. (2)

2.5.14.1.1.2.3.2 Liaise and participate in Western Hemisphere Shorebird Reserve Network, Piping Plover Registry and other wildlife programs. (2)

2.5.14.1.1.2.3.3 Exchange information, identify protocols/needs and/or catalyse action through international program work in Mexico and the Caribbean, including Cuba. (2)

2.5.14.2 Communicate with relevant groups and organizations. (2)

2.5.14.2.1 Provide awareness through brochures. (2)

2.5.14.2.1.1 Increase general awareness of all public and stakeholders on the current status/problems of Piping Plover and their habitat. (2)

2.5.14.2.2 Change behaviour/influence/re-inforce major policy plans and any managers to understand the consequences of their action so best available alternative approaches and/or mitigation techniques are used. (2)

2.5.14.2.2.1 Landowners and land managers. (2)

2.5.14.2.2.1.1 Identify private, corporate and government landowners. (2)

2.5.14.2.2.1.2 Notify all landowners whose lands support Piping Plovers or land users influence Piping Plovers on adjacent lands of the importance of Piping Plovers and the possible effect of their land use may have. (2)

2.5.14.2.2.1.3 Make personal contacts with landowners during field programs. (2)

2.5.14.2.2.1.4 Give public recognition of private conservation and/or participation in cooperative conservation projects. (2)

2.5.14.2.2.2 Facilitate land users information awareness. (2)

2.5.14.2.2.2.1 Prepare and distribute appropriate information to allow recreationists to modify behaviour, understand management programs and use restrictions. (2)

2.5.14.2.2.2.2 Provide information to industrial/commercial users to allow them to design and plan their programs in a manner which is supportive of Piping Plover recovery. (2)

2.5.14.2.2.2.2.1 Develop and distribute voluntary guidelines/code of practise for users in potential conflict with Piping Plovers. (2)

2.5.14.2.2.2.2.2 Ensure that agency people have input into Environmental Impact Assessments and Environmental Impact Statements to heighten awareness of Piping Plover habitat and biological needs and ensure the needs are considered during reviews. (2)

2.6 Stepdown outline for recovery of the Atlantic Canada Piping Plover population (Priority of tasks in brackets)

2.6.1 Monitor population status and distribution.

2.6.1.1 Continue to participate in international census every five years. (1)

2.6.1.2 Support periodic mini-census and other surveys during breeding season. (2)

2.6.1.3 Support annual population surveys. (2)

2.6.2 Define habitat requirements.

2.6.2.1 Establish guidelines for the identification of important elements of critical habitat. (1)

2.6.2.2 Identify essential breeding habitat required to attain population target goals. (1)

2.6.2.3 Identify critical wintering habitat. (1)

2.6.2.4 Identify and rate quality of nesting habitat. (2)

2.6.2.4.1 Develop methods to rate habitat and identify factors that affect habitat quality. (2)

2.6.2.4.2 Determine attributes of occupied and unoccupied "potential" habitat. (2)

2.6.2.4.3 Determine carrying capacity of habitats in Atlantic Canada. (2)

2.6.2.5 Determine core beach management requirements needed to achieve population and productivity goals. (2)

2.6.3 Determine population size and productivity needed to attain population goals.

2.6.3.1 Determine population size required to achieve recovery goal. (2)

2.6.3.2 Annually determine population size and productivity at key habitat sites. Compare productivity on guardian beaches with productivity elsewhere. (2)

2.6.3.3 Periodically evaluate whether 1.5 chicks/pair/year productivity rate is sufficient to ensure species survival in Atlantic Canada. (2)

2.6.4 Protect and enhance habitat.

2.6.4.1 Protect nesting and potential nesting beaches. (1)

2.6.4.1.1 Protect nesting areas by minimizing human disturbance. (1)

2.6.4.1.1.1 Promote involvement of private landowners, community-based conservation groups and other nongovernment agencies in protection of important nesting beaches. (1)

2.6.4.1.1.2 Use symbolic fencing and signs to minimize human disturbance and control pets in high use beach areas where feasible. (1)

2.6.4.1.1.3 Increase enforcement activities and education to reduce disturbance, mortality and habitat degradation caused by ATVs. (1)

2.6.4.1.2 Protect nests from predation. (2)

2.6.4.1.2.1 Remove predator attractions (litter and garbage) using techniques that will not disturb or harm Piping Plovers or their habitat. (1)

2.6.4.1.2.2 Use exclosures where appropriate (see United States Fish and Wildlife Service [1996] for general guidelines pertaining to use of exclosures). (2)

2.6.4.1.2.3 Control predator populations when considered warranted, feasible and where it is an acceptable policy. (2)

2.6.4.1.3 Promote long-term protection for plovers and their habitat. (1)

2.6.4.1.3.1 Establish and work towards achieving habitat protection goals. (1)

2.6.4.1.3.2 Implement landowner stewardship on private lands when practical and as part of annual habitat protection effort. (1)

2.6.4.1.3.3 Seek opportunities for securing additional habitat using protective designations. (1)

2.6.4.1.3.4 Encourage involvement of conservation groups in acquisition of core plover habitat. (1)

2.6.4.2 Maintain natural coastal formations, particularly beach habitat. (1)

2.6.4.2.1 Support the development of comprehensive beach conservation strategies to ensure sustainable use of coastal areas. (2)

2.6.4.2.2 Discourage developments that will destroy or degrade habitat. (1)

2.6.4.2.3 Discourage dune stabilization efforts in areas where Piping Plover washover habitat will develop. (2)

2.6.4.2.4 Create or modify habitat. (3)

2.6.4.2.4.1 Promote experimental modification of vegetation where encroachment on nesting sites has occurred. (3)

2.6.4.2.4.2 Investigate modification of vegetation and substrate for potential benefits, including addition of sand and gravel, exploring the use of dredge spoils to create new habitat and enhance existing habitat. (3)

2.6.4.3 Support the development of contingency plans for oil spills and detrimental effects of contaminants where these are considered feasible and necessary for species survival. (3)

2.6.5 Initiate and support Piping Plover research to aid in recovery efforts.

2.6.5.1 Initiate studies on population parameters including factors affecting productivity, survival, and adult mortality during nesting, migration and in wintering areas. (2)

2.6.5.2 Initiate studies of plover ecology, including food utilisation and availability, competition and effects of climate. (3)

2.6.5.3 Initiate research to determine long-term population viability including genetic studies. (3)

2.6.5.4 Support research and monitoring to detect the presence of toxins in breeding and wintering areas. (3)

2.6.5.5 Support research aimed at enhancing husbandry techniques using salvaged eggs. (3)

2.6.6 Develop and implement public information and education programs.

2.6.6.1 Develop a network for production and distribution of information and educational materials. (2)

2.6.6.2 Support and promote continuation and enhancement of the efforts of nongovernment organizations. (1)

2.6.7 Evaluate recovery actions annually.

2.6.7.1 Assess population trends. (2)

2.6.7.2 Revise recovery efforts as required. (2)

2.6.7.3 Evaluate effectiveness of recovery programs. (1)

Section 3
Implementation tasks

Recovery actions for the Prairie and Atlantic regions are outlined in Tables 2 and 3. The period covers five fiscal years — 2000 through to 2004. Tasks are rated according to priority and assigned to agencies taking lead and/or cooperating roles. Projected completion dates are given. Priority ratings are those developed by the United States Fish and Wildlife Service (United States Fish and Wildlife Service 1978):

"Priority 1: An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future."

"Priority 2: An action that must be taken to prevent a significant decline in species population or habitat quality, or some other significant negative impact short of extinction."

"Priority 3: All other actions necessary to provide for full recovery (or reclassification) of the species."

Disclaimer:
The goals, objectives, and recovery actions identified in this plan are subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations, as well as to modifications resulting from changed objectives or new findings.

Key to implementation Table 2:

CWS	Canadian Wildlife Service
PROVS	Ontario, Manitoba, Saskatchewan, Alberta
NGOs	Nongovernment organizations
USFWS	United States Fish and Wildlife Service
STATES	U.S. states

Key to implementation Table 3:

CWS	Canadian Wildlife Service
PROVs	New Brunswick, Nova Scotia, Newfoundland and Labrador, Prince Edward Island, Québec
MUN	Municipalities
RCMP	Royal Canadian Mounted Police
NGOs	Nongovernment organizations
TEAM	Atlantic Canada Piping Plover Recovery Team
PC	Parks Canada Agency
UNIV	Universities
AVC	Atlantic Veterinary College

Table 2
Implementation tasks (2000–2004) for Canada's Piping Plover recovery plan: Prairie and Ontario regions

Action	Recovery Plan no.	Priority	Responsibility		Target date	Estimated costs ($000s)*				
			Lead	Cooperators		00	01	02	03	04
A. Background studies and research										
1. Carry out population surveys	2.5.1.1	2	CWS	PROVS, NGOs	Annual	12	80	12	12	12
2. Census potential new breeding sites	2.5.2	2	PROVS	CWS, NGOs	Annual	1	5	1	1	1
3. Monitor productivity at key sites	2.5.4.1	2	CWS	PROVS, NGOs	Annual	20	20	95	95	95
4. Differentiate productivity in different habitats	2.5.4.2	2	CWS	PROVS, NGOs	2004	95	135	135	135	135
5. Determine diet	2.5.6.3	2	CWS	PROVS, NGOs	2004	–	–	20	20	20
6. Test unhatched eggs for chemical contamination	2.5.8	2	CWS	PROVS, NGOs, USFWS	Annual	15	15	15	15	15
7. Model population	2.5.13.3	2	CWS	PROVS, USFWS, NGOs	2002	–	–	25	–	–
8. Understand biology at ecologically different sites	2.5.13.4	2	CWS	PROVS, NGOs	2003	–	60	60	60	–
B. Management										
1. Develop standard habitat assessment methods	2.5.6.1	3	PROVS	CWS	2000	1	–	–	–	–
2. Rate habitat at 2001 international census sites	2.5.6.2	3	PROVS	CWS, NGOs	2001	–	50	–	–	–
3. Identify threats to habitat	2.5.6.4	1	PROVS	CWS, NGOs	Annual	5	50	5	5	5
4. Document threats in all studies	2.5.6.5	2	PROVS	CWS, NGOs	Annual	65	130	90	95	90
5. Document threats at 2001 international census sites	2.5.6.6	2	PROVS	CWS, NGOs	2001	–	50	–	–	–
6. Identify standard census data to be collected	2.5.7.1	3	CWS	PROVS	2000	1	–	–	–	–
7. Identify breeding habitat	2.5.9.1	2	PROVS	CWS, NGOs	Annual	12	3	20	15	15
8. Protect breeding habitat	2.5.9.2	1	PROVS	CWS, NGOs	Ongoing	135	135	135	135	135
9. Protect and manage watersheds	2.5.9.3	1	PROVS	CWS, NGOs	Ongoing	230	440	235	330	330
10. Manage breeding sites to reduce mortality and increase productivity	2.5.9.4	2	PROVS	CWS, NGOs	Ongoing	77	227	82	77	77
11. Identify and protect winter habitat	2.5.3	2	CWS	NGOs, USFWS, STATES, MEXICO	Ongoing	–	5	–	–	–
12. Increase productivity through management techniques	2.5.13.1	2	PROVS	CWS, NGOs	Ongoing	125	125	125	125	125
13. Prevent human disturbance	2.5.13.2	2	PROVS	CWS, NGOs	Annual	10	10	10	10	10
14. Assess recolonization in Great Lakes	2.5.13.5	3	ONTARIO	CWS, NGOs	2002	–	–	5	–	–
C. Administration/funding/public relations										
1. Store and maintain data at Conservation Data Centres and CWS	2.5.7.2	3	NGOs, CWS	PROVS	Annual	8	4	5	2	2
2. Protect species through legal and other protocols	2.5.10	1	CWS, PROVS		Ongoing	2	2	2	2	2
3. Maintain public and administrative support	2.5.11	2	CWS, PROVS	NGOs	Ongoing	5	5	5	5	5
4. Coordinate recovery action	2.5.14.1	2	CWS	PROVS, USFWS	Ongoing	15	20	15	15	15
5. Communicate with relevant groups and organizations	2.5.14.2	2	CWS	PROVS, NGOs	Ongoing	7	15	25	5	5
D. Monitoring and evaluation										
1. Determine population size and productivity at managed sites	2.5.5.1	2	PROVS	CWS, NGOs	Annual	155	155	155	155	155
2. Monitor and evaluate effectiveness of recovery	2.5.12	1	CWS	PROVS	Annual	12	12	12	12	12

* Estimates listed are for activities conducted separately. Note that some activities are linked, whereby if one activity is undertaken, the cost of the related activity will be less than if only one activity is conducted. Dollar values are estimates of activity costs and will in most cases not reflect actual dollars spent or activities undertaken. Cumulative task cost, omitting duplicate activity estimates, is estimated to be about $4.4 million.

Table 3
Implementation tasks (2000–2004) for Canada's Piping Plover recovery plan: Atlantic and Québec regions

Action	Recovery Plan no.	Priority	Responsibility: Lead	Responsibility: Cooperators	Target date	Estimated costs ($000s)[1]: 00	01	02	03	04
A. Monitor population status and distribution										
1. International census	2.6.1.1	1	CWS	PROVS, PC, NGOs	2001	–	30	–	–	–
2. Periodic mini-census	2.6.1.2	2	PROVS*, PC, NGOs	CWS	2004	–	–	–	–	–
3. Annual population surveys	2.6.1.3	2	PROVS, PC, NGOs	CWS	annual	15	15	15	15	15
B. Define habitat requirements										
1. Establish guidelines for the identification of critical habitat	2.6.2.1	1	TEAM		2000	8	5	5	5	5
2. Identify essential breeding habitat	2.6.2.2	1	PROVS*	PC, CWS	annual	5	5	5	5	5
3. Identify essential wintering habitat	2.6.2.3	1	CWS		2002	15	15	25	25	25
4. Methods to rate beach quality	2.6.2.3.1	2	PROVS*	CWS	annual	10	10	5	5	–
5. Carrying capacity of beaches in Atlantic Canada	2.6.2.3.3	1	CWS, PROVS*		2000	15	15	–	–	–
6. Determine beach management requirements to achieve population and productivity goals	2.6.2.4	2	CWS	PROVS	2001	5	5	5	–	–
C. Determine population size and productivity needed to attain target										
1. Determine population size required to achieve recovery goal	2.6.3.1	1	CWS	PROVS	2000	–	–	–	–	–
2. Productivity in priority habitat	2.6.3.2	2	CWS	PROVS, NGOs	annual	20	20	20	20	20
3. Evaluate productivity target	2.6.3.3	2	TEAM		periodic	–	–	–	–	–
D. Protect and enhance habitat										
1. Minimize human disturbance	2.6.4.1.1	1	PROVS*, CWS	NGOs, RCMP	annual	238	238	238	238	238
2. NGO and volunteer protection efforts	2.6.4.1.1.1	1	All*	CWS	annual	200	200	200	200	200
3. Symbolic fencing	2.6.4.1.1.2	1	PC, PROVS*, NGOs		annual	8	8	8	8	8
4. Reduce impact of ATVs	2.6.4.1.1.3	1	PROVS*, MUN	RCMP	annual	30	30	30	30	30
5. Decrease predation	2.6.4.1.2	2	PROVS*, PC		annual	3	3	3	3	3
6. Litter and garbage management	2.6.4.1.2.1	1	PROVS*, PC		annual	8	8	8	8	8
7. Exclosures where appropriate	2.6.4.1.2.2	2	PROVS*, PC, NGOs		annual	10	10	10	10	10
8. Control predators	2.6.4.1.2.3	2	PROVS*, PC		annual	0.5	0.5	0.5	0.5	0.5
9. Establish beach protection goals	2.6.4.1.3.1	1	PROVS*		2000	10	10	10	10	10
10. Assess potential for landowner stewardship	2.6.4.1.3.2	1	PROVS*		2002	15	15	15	0	3
11. Secure nesting habitat	2.6.4.1.3.3	1	PROVS*, NGOs		2003	50	50	50	50	50
12. NGO involvement to secure habitat	2.6.4.1.3.4	1	PROVS*, CWS		ongoing	5	5	5	5	5
13. Discourage habitat destruction	2.6.4.2.2	1	PROVS*	All	ongoing	10	10	10	10	10
14. Minimize disturbance of natural dune processes	2.6.4.2.3	2	PROVS*		ongoing	5	5	5	5	5
15. Experimental vegetation alteration	2.6.4.2.4.1	3	PC		2000	2	5	5	5	5
16. Contigency plans for oil spills and contaminants	2.6.4.3.1	3	CWS		2001	2	2	–	–	2

Continued next page

Table 3 (*cont'd*)
Implementation tasks (2000–2004) for Canada's Piping Plover recovery plan: Atlantic and Québec regions

Action	Recovery Plan no.	Priority	Responsability		Target date	Estimated costs ($000s)[1]				
			Lead	Cooperators		00	01	02	03	04
E. Piping Plover Research										
1. Population parameters	2.6.5.1	2	CWS		ongoing	20	20	20	20	20
2. Ecology	2.6.5.2	3	UNIV		ongoing	10	10	10	10	10
3. Population viability	2.6.5.3	1	CWS, PROVS*, PC		2001	8	8	8	0	2
4. Effects of toxins	2.6.5.4	3	CWS, AVC		ongoing	2	2	2	2	2
5. Husbandry techniques	2.6.5.5	3	CWS, PC		2002	2	3	3	3	-
F. Develop and implement public information and education programs										
1. Develop and distribute information	2.6.6.1	2	All		annual	10	10	10	10	10
2. Promote volunteer efforts	2.6.6.2	1	All		annual	7	7	7	7	7
G. Evaluate recovery actions annually										
1. Assess population trends	2.6.7.1	2	CWS, PROVS*		annual	5	5	5	5	5
2. Revise recovery efforts	2.6.7.2	2	TEAM		ongoing	5	5	5	5	5
3. Evaluate effectiveness of programs	2.6.7.3	1	TEAM		annual	10	10	10	10	10

[1] Note that some activities are linked whereby if one activity is undertaken, the cost of the related activity will be less than if only one activity is conducted. Estimates listed are for activities conducted separately.

* In the case of Quebec, CWS–Quebec Region will have the lead and the province will be a collaborator.

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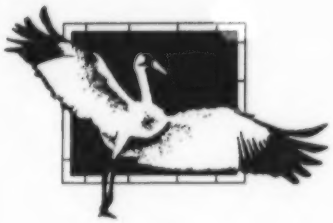
Previous National Recovery Plans

1. Canadian Whooping Crane Recovery Plan	December 1987
2. *Anatum* Peregrine Falcon Recovery Plan	October 1988
3. National Recovery Plan for the Baird's Sparrow	April 1993
4. National Recovery Plan for the Roseate Tern	June 1993
5. National Recovery Plan for the Greater Prairie-Chicken	October 1993
6. National Recovery Plan for the Whooping Crane (1994 update)	January 1994
7. National Recovery Plan for the Loggerhead Shrike	March 1994
8. National Recovery Plan for the Marbled Murrelet	May 1994
9. National Recovery Plan for the Gaspésie Caribou	November 1994
10. National Recovery Plan for the Vancouver Island Marmot	December 1994
11. National Recovery Plan for the Ferruginous Hawk	December 1994
12. National Recovery Plan for the Harlequin Duck in Eastern North America	March 1995
13. National Recovery Plan for the Burrowing Owl	April 1995
14. National Recovery Plan for the Newfoundland Marten	August 1995
15. National Recovery Plan for the Swift Fox	April 1996
16. National Recovery Plan for the Blanchard's Cricket Frog	March 1997
17. National Recovery Plan for the Henslow's Sparrow	August 1997
18. National Recovery Plan for Blandings Turtle (*Emydoidea blandingii*) Nova Scotia population	January 1999
19. National Recovery Plan for the Vancouver Island Marmot (*Marmota vancouverensis*) 2000 Update	May 2000
20. National Recovery Plan for Acadian Flycatcher (*Empidonax virescens*) and Hooded Warbler (*Wilsonia citrina*)	November 2000
21. National Recovery Plan for Wood Bison (*Bison bison athabascae*)	October 2001

Recovery of Nationally Endangered Wildlife



In 1988, the Wildlife Ministers' Council of Canada endorsed a new strategy to rescue wildlife species at risk of extinction and to prevent other species from becoming at risk. Called RENEW (the acronym for Recovery of Nationally Endangered Wildlife), the strategy brings together all responsible agencies and interested organizations and individuals to work as a team for the recovery of wildlife at risk. RENEW focuses on those species or populations that have been designated as extirpated, endangered, or threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The responsible jurisdictions establish a National Recovery Team of experts for each species to produce a recovery plan, which becomes the basis for a recovery program carried out by the responsible governments in cooperation with aboriginal groups, universities, nongovernment organizations, businesses, and private citizens.

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